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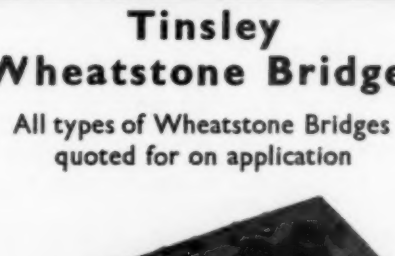

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Prehistory in South Africa

IN a letter appearing in a recent issue of NATURE (June 4, p. 1010) Sir Arthur Keith, commenting on the significance of the Florisbad skull for the study of the origins and distribution of early racial types and its place in the African series of primitive forms of man, drew a remarkable, and at first sight startling, conclusion from a recent examination of a cast of the skull. Pointing, in full agreement, to the anatomical analysis by Dr. Alex. Galloway of the characters of the Florisbad find, from which it appears that Neanderthaloid characteristics are here found accompanying features such as occur in the Boskop skull—a 'modern' type, which Sir Arthur regards as proto-Bushman—he goes on to suggest that not only is Florisbad man a transitional form from Rhodesian man to Boskop man, as Dr. Galloway maintains, but also that he heralds the modern Hottentot and Bushman races of South Africa. The skull is, he says, "a mosaic of Rhodesian, Boskop and Bush characters".

Hence it would appear that Sir Arthur finds in the Florisbad skull a link in the chain of evidence for the theory of the continental evolution of modern racial types, which he put forward some two years ago (see NATURE, **138**, 194; Aug. 1, 1936), and for which he then sought support in the Mongoloid appearances which Prof. F. Weidenreich had detected in the teeth and jaws (and later found in the form of the nose) of Peking man.

It may not be out of place to note in this connexion that even Rhodesian man in certain characters shows an approach to the modern type, in contrast with the primitive facial skeleton—a contrast which moved the late Sir Grafton Elliot Smith to say at first sight that apparently the face was the latest feature to be affected by the evolutionary process. It will be remarked, however, that in the Florisbad skull it is the face, and more especially the forehead, in which the approach to the 'modern' is most marked.

Sir Arthur Keith's letter in NATURE, to which reference is made above, should be read in conjunction with the reference to the Florisbad find made by Mr. A. J. H. Goodwin in the course of a survey of recent advances in South African prehistory, which appears in the current issue of *Scientia* (iii), **32**, 1–6; 1938). Mr. Goodwin there points out that the Florisbad skull, which was found in association with extinct animal forms and stone implements by Dr. T. F. Dreyer in 1935 and has been studied by Prof. M. R. Drennan and others, after reconstruction, is the first specimen of a human skull from Africa which may be said to show true Neanderthal characteristics, if *H. Rhodesiensis* be excluded. A further point of importance and great interest, in view of Sir Arthur Keith's conclusions, to which he also refers, is the possibility of a relationship with Prof. Broom's Korana type and the Cape Flats skull. The significance of this will be appreciated if reference be made to the account of the physical characters and culture of the inhabitants of the Oakhurst rock-shelter (see p. 1146 and p. 1151), in which Prof. Drennan finds Hottentot characteristics in the skeletal remains of a people definitely not, or perhaps it should be said not yet, Hottentot in culture. We appear here to be getting very near a chain of positive evidence, with collateral support, for Sir Arthur Keith's independent suggestion that the Florisbad skull, as a transition from the Rhodesian skull to the Boskop type, heralds the modern Hottentot and Bushman races of South Africa.

A further link in the chain of argument is supplied by an account by Sir Arthur Smith Woodward of a fossil skull of an ancestral Bushman, found on the foreshore of the Blue Nile at Singa, about two hundred miles south of Khartoum (*Antiquity*, June 1938). He points out that this find is of great interest in view of the fact that it is now recognized that during the Pleistocene, and even during a later prehistoric period, there were in northern Africa human races related to the existing Bushman and the Hottentots of the south; while the shape of the skull in some of the early Egyptians suggests relationship to the Bushman.

This specimen was found in February 1924, by Mr. W. G. R. Bond, then governor of the Fung Province of the Anglo-Egyptian Sudan. It was embedded in a limestone concretion, a few feet above low-river level. It is still partly embedded in the hard matrix, but it has been cleaned enough to exhibit its principal characteristics.

Without entering into the detailed description of the skull given by Sir Arthur, his main conclusions may be mentioned. The skull, it is said, is shorter and wider than the ordinary skulls of Bushmen, but its proportions are not very different from those of a few exceptional examples. It resembles the Bushman, first in the fullness of the frontal region and the slight longitudinal keel in its upper part; secondly, in the flattening of the middle part of the cranial roof; and thirdly, in the prominence of the large parietal bosses and the medium longitudinal depression between them. Other resemblances need not detain us; but the differences are no less important from the point of view with which we are here concerned. For this Singa skull differs from the Bushman in the greater prominence of the supraorbital ridges and in the forward curve of the nasal bones, which indicate a less shortened facial region. It may indeed, Sir Arthur concludes, be regarded as belonging to an ancestral Bushman type, in which the face has not yet shrunken. It is, therefore, especially significant that although Sir Arthur considers that this skull differs from all human skulls hitherto described as found fossil in North Africa, it presents certain resemblances with the skulls found at Afalou-bou-Rhummel in Algeria by Dr. C. Arambourg; but, it is added, in its most important features it agrees still more closely with the Boskop skull, of which it appears to be a brachycephalic variant. The modern Bushman, says Sir Arthur, summing up, may be regarded as a degenerate localized type, with shortened face and protuberant brain-case, of a normal-sized vigorous race, once distributed widely in Africa.

To return to the Florisbad skull. Its special interest for the prehistorian lies in the precision with which it can be assigned to a cultural setting. The stone implements, which were found with the skull, of indurated shale, belong to the Middle Stone Age of South Africa. There is present in them, Mr. Goodwin points out, a very clear Mousterian tradition. The most typical form is a flat long triangular point, showing convergent flaking and a faceted butt. With this are later types, backed blades, parallel flakes and so on. Burins also occur. The culture is, in fact, a typical variant of the South African Middle Stone Age.

The special significance of the find in this relation is, as Mr. Goodwin goes on to indicate, that the discovery of Neanderthaloid characteristics in the skull in association with implements bearing Mousterian stigmata in South Africa is new. Hitherto, the skulls which have been found in certain association with implements of this general group have all belonged to the type of *H. sapiens*; but, he adds, until the chronological relationship between the Florisbad site and other Middle Stone Age deposits has been the subject of more detailed work, it is unfair to draw further conclusions. It may, however, be added that in the survey of the Vaal River gravels, which has been carried out by Dr. R. van Riet Lowe, as summarized by Mr. Goodwin, the Middle Stone Age is associated with the Third Wet Phase after the deposition of the youngest gravels, this being the third and latest of the three series of deposits which have been described. It is, however, significant that in South Africa the Middle Stone Age, though it has its origins in the Mousterian, would appear to have lasted considerably longer than in its European variant, and as it develops shows increasing influence of Upper Palæolithic type. The Later Stone Age diverges still further from any European cultures, and may best be related to the Capsian and later cultures of North Africa.

Lastly, to complete the picture, it may be mentioned that the Oakhurst Rock Shelter (see p.1151) presents a full history of the local facies of the Later Stone Age, ranging, after the temporary use of the shelter, from Smithfield *B* cultures to the latest forms in a developed Wilton, the closing phase of Old Stone Age.

Life Work of Elliot Smith

Sir Grafton Elliot Smith: a Biographical Record by his Colleagues. Edited by Warren R. Dawson. Pp. 272 + 3 plates. (London: Jonathan Cape, Ltd., 1938.) 12*s*. 6*d*. net.

TO Grafton Elliot Smith the pious hands of friends and colleagues have erected in this book "a monument more lasting than brass". A biographical sketch by Mr. Warren Dawson—based largely on letters written by Elliot Smith himself (for he preserved few or none addressed to him), two autobiographical fragments, of which the writing was interrupted by his death, and an account of his Cambridge days, also unfinished owing to the death of its author, Lord Rutherford, are followed by chapters, each contributed by someone most intimately in touch with him in a particular phase of his life or work.

After the period of formal education and training in Australia and at Cambridge, which closed with the acceptance of a professorial chair at Cairo in 1900, Elliot Smith's career, broadly speaking, was marked off into three phases: his work in Egypt from 1900 until 1909, of which an account supplementary to that of the main narrative, and dealing more particularly with his work in the Archæological Survey of Nubia, is given by Prof. F. Wood-Jones; secondly, his tenure of the chair of anatomy at Manchester from 1909 until 1919, which is recorded by Prof. J. S. B. Stopford; while Prof. H. A. Harris tells the story of the third period and the great work he carried out in the reorganization of his department at University College as professor of anatomy in the University of London from 1919 until the end. Prof. J. T. Wilson, formerly of Sydney, tells us of his early work as student and research worker, Dr. A. J. E. Cave surveys his contribution to knowledge in anatomy and neurology, and Dr. W. J. Perry, who was perhaps closest to him in the later part of his life, reviews his contribution to ethnological theory in the doctrine of the diffusion of culture and the origin of civilization in ancient Egypt.

The account of Elliot Smith's life and work given here is expository and descriptive rather than critical. The opposition with which his views on the diffusion of culture were greeted receives frequent mention; but no attempt is made to estimate how far, if at all, it was valid. It is treated throughout as negligible—a mere fluttering in academic dovecotes.

Apart from this weakness—and it is undoubtedly a weakness—this biography is a worthy tribute to a great man; and for once the eulogy of friends has drawn no distorted portrait. His loyalty to his friends was never failing and was repaid by a like devotion and understanding. Elliot Smith's one great failing, however, was an extreme sensitiveness to criticism, which reacted in a trenchant retort, too little apprehensive of a like sensitiveness in others. It veiled from many the essential kindliness, generosity and honesty that lay behind it all. It helped to obscure in the eyes of opponents the fact that Elliot Smith's work on both the physical and the cultural side of the study of man was essentially a logical and philosophic unity. His excursions into the cultural field, whatever their failings, were not merely the eccentric aberrations of genius, as many regarded them. It was this synthetic quality of his mind which led him, when at the close of the Great War he was deeply impressed by the significance of psychology, to formulate his conception of the study of man as a scheme of 'human biology'.

When Elliot Smith went from Australia to Cambridge, he was already well on the way to establishing a reputation as research worker and original thinker; but his appointment to the chair at Cairo was to exercise a decisive influence on his career. Within a very short time after this appointment his comparative studies of the mammalian brain had secured him a position of widely recognized authority. This he would have achieved in any environment which made research at all possible; but Egypt gave him something which he could have attained nowhere else. His examination of the technique of mummification and of the skeletal material brought to light in the archæological survey of Nubia, material extending over a prolonged period of time, gave him a new perspective in the investigation of the problems of human physical and cultural development. He was led in two directions: on one side are his contributions to palæopathology based upon the study of the evidence of disease, etc., in the skeletal remains of the ancient Egyptians, work continued by Prof. Wood-Jones; and on the other his analysis of the physical characters of the early population of Egypt, in which he detected the infiltration of a new race, the 'Armenoids', to whom he attributed the introduction of copper, with consequences in cultural development, upon which he enlarged in "The Ancient Egyptians" (1911).

This book many have considered contained some of his most original work in an all-round sense. W. H. R. Rivers, a few weeks after he himself had put before the anthropologists from the presidential chair of Section H at the Portsmouth meeting of the British Association analogous views on cultural development in the Pacific, wrote in a private letter that he had just read this book and was "wildly excited about it". Subsequent developments have perhaps tended to obscure the essential merits of a brilliant piece of research in racial analysis and history.

While these ideas concerning the racial history of the Mediterranean peoples and the cultures with which they were associated were incubating, Elliot Smith was no less busily engaged on his study of the development of the human brain, of which he gave the result to the world in his presidential address to the anthropological section at the Dundee meeting of the British Association in 1912. Possibly it would be no unfair judgment to say that it was at this point that Elliot Smith's work began to come to its full fruition. His correlation of the development of the brain and the acquisition of stereoscopic vision with the bodily modification and functional expansion, which made possible man's development in culture, are fundamental in all later studies of the course of human evolution; while his contributions to discussion of the specimens of early man which were discovered from time to time—Piltdown man, Rhodesian man, the London skull, *Australopithecus*, and above all Peking man, gave his views unquestioned authority. He was universally accepted as joint arbiter with Sir Arthur Keith on any and every skeletal fragment of early man in whatsoever quarter of the globe it might be found.

Such, in brief outline, are the salient features in a career in which Elliot Smith raised himself to an outstanding position among men of science of our time—a position in which his intellectual influence made itself felt far outside academic circles. It was in a measure the triumph of a personality, which impressed in one sense or another all who came into contact with him, and of which the essential qualities and their effect on his immediate circle may be gauged from the revealing volume for which we are indebted to Mr. Dawson and his collaborators.

Genetics of Developmental Processes

Physiological Genetics

By Prof. Richard Goldschmidt. (McGraw-Hill Publications in the Zoological Sciences.) Pp. ix + 375. (New York and London: McGraw-Hill Book Co., Inc., 1938.) 24*s*.

PROF. GOLDSCHMIDT'S "Physiologische Theorie der Vererbung" was familiar to all serious students of genetics, and they will welcome the present book, in which the same ideas are developed in view of the last ten years' work of the author and others. The University of Berkeley, California, is fortunate in having been able to add Prof. Goldschmidt to its already world-famous school of genetics, and English students of genetics will be grateful for this book in their own language.

As an account of the genetics of developmental processes, it will prove indispensable. Among the most fascinating topics dealt with are the author's own work on the development of the wings in the 'vestigial' and 'truncate' series of allelomorphs in *Drosophila*, where the wing is normal in its early development, and lysis sets in later on, sometimes only after pupation. Sueffert found that the 'tails' on the wings of *Papilio podalirius* were produced by a similar process, which in some related species is gene-controlled. Equally interesting is Kühn's analysis, by genetical and physiological methods, of the determination of the wing pattern in *Ephestia kühniella*, and those of Zeleny, Hersh, Harnly, Plunkett and others on the temperature co-efficients of growth-rates in mutant forms.

While this book covers such topics as these very fully, it is somewhat deficient on the purely physiological side. It is startling that the name of Garrod is not even mentioned, although he was the first to show the importance of genetics for human physiology by his classical studies on alcaptonuria. Also the work of Beadle and Ephrussi on the precursors of the eye pigments in *Drosophila* is perhaps given less complete treatment than it deserves. This may be a matter of temperament. It is good, with Goldschmidt and Henke, to trace the path in the organism of an unidentified gene-controlled substance. It is better, with Beadle and Ephrussi, to be able to transfer it from one organism to another. But it is still better, perhaps, to obtain it in pure crystalline form, and to say, with Scott-Moncrieff or Penrose, that a particular gene is responsible for inserting a hydroxyl group at a particular point on the molecule. That at least is the reviewer's point of view. But it may well be that had Goldschmidt adopted it he would never have arrived at his extremely fruitful theory of the genic control of growth-rates.

Yet a more physiological outlook might have restrained the author from the rather revolutionary conclusions of the last chapter. Until recently he supported the view that different allelomorphs in the same locus merely differed quantitatively in the amount of gene substance which they contained. He has now reacted violently from this over-simple theory, and holds that there is no such thing as a normal, or wild type, gene. The chromosome is a physiological whole, and genes are merely steric re-arrangements of parts of it, altering its functions in various ways.

This is a natural reaction from the theory that the genes could be legitimately represented as points without parts of magnitude on a line. This was obviously a crude approximation to the truth. But it may still be very useful. It is just such work as Garrod's which, to the reviewer, seems to lead up to a truly physiological theory of the gene as an elementary organ with a definite function, and located in a definite region of a chromosome. The functions of the normal genes are concerned with those phases of intermediary metabolism which are upset in the mutants. On this view there is nothing strange in the possibility that two genes may overlap spatially, as for example the digestive and endocrine functions of the pancreas do. Nor is it surprising that a gene transplanted by a translocation may alter its function, as, for example, a pancreas discharging its juice to the outside through a fistula loses its digestive but not its endocrine function, or an ovary transplanted to a rabbit's ear secretes hormones of a male type. It may be that Goldschmidt has gone a little too far in his reaction from a crudely mechanistic gene theory. Mechanistic theories are not wholly true, but they are partly so; and the statement that an organism or a chromosome is a whole is no compensation for a lack of knowledge of its parts. Nevertheless, it is valuable that the case against the existence of wild type genes should be put so strongly as Goldschmidt has put it, if only to stimulate discussion.

I have only noticed one error in the book, where on p. 24, the fluid in the blebs of abnormal mouse embryos is said to be an extravasate. On the other hand, there are a number of passages in which the author does not use the normal English idiom, and where a revision would have been desirable. But these minor defects will not prevent geneticists from buying a book which is unique as a guide to the literature and stimulating even where it is perverse.

J. B. S. HALDANE.

Sound Waves

Sound Waves, their Shape and Speed: a Description of the Phonodeik and its Applications and a Report on a Series of Investigations made at Sandy Hook Proving Ground. By Prof. Dayton Clarence Miller. Pp. xi + 164. (New York: The Macmillan Co., 1937.) 12*s.* net.

IN "The Science of Musical Sounds", published in 1916, Prof. Dayton C. Miller made available the substance of a series of eight lectures he had given at the Lowell Institute in 1914. The treatment and presentation of his subject were dictated by those circumstances. Though the results of his own investigations rightly received a due share of attention, their description appeared in a setting of "elementary and well known material". Thus the phonodeik, with which the account of those investigations began, was not mentioned until page 78 was reached in a book which, excluding the appendix, contained 270 pages. Moreover, as was natural in a record of lectures in which the audience had a phonodeik before their eyes, the description of the instrument was somewhat brief.

In his new book "Sound Waves, their Shape and Speed", Prof. Miller has produced a story of his investigations which is the complement of his earlier work. Its pages give a straightforward description of his objectives, the methods of attack, the experimental difficulties to be overcome, the means adopted to that end, and a brief outline of the results. The word "story" is used advisedly; for it is this simplification of aim which lends to the book its very real interest. Prof. Miller is not describing a new field of knowledge; Georg S. Ohm and Hermann von Helmholtz had made its general characteristics known more than seventy-five years ago. He is giving a narrative of many years work which has filled in, by the most careful experiment, the details of a large part of the country traversed. That is why few instructed readers who begin the book will be able to lay it aside until they have reached the last page.

As its title implies, the book falls into two parts, dealing in turn with the shape of sound waves and with their speed. The first part sets out much that is of direct interest to musical men of science, particularly in these days when electronic organs are making us acquainted with the synthesis of musical sounds. The six plates have been selected

from the musician's point of view. Once the reader has realized, as he cannot fail to do from the description of the technique employed, that the photograph is that of a transverse vibration depicting, as it were diagrammatically, a longitudinal vibration of the most minute character in the air, the curves selected tell their own story. They are all capable of interpretation by the eye, and they cover in a representative manner results of a wide range of interest. Little knowledge of physics other than that which can be picked up by a careful reader is required for their interpretation.

The author gives a much fuller description of the phonodeik than appeared in his earlier book; and this will be useful to anyone interested in the details of his apparatus. In Prof. Miller's own words: "For the investigation of the tone quality of musical instruments, a permanent graphical record of the wave form of the sound seemed necessary; none of the methods for recording sound was sufficiently sensitive and free from influences producing distortion of the wave form." Dimensions and diagrams are given for the constructional details, but it may perhaps be suggested that, in a future edition, a couple of pages at the end of the book might record, for convenience of future reference, actual working drawings for the complete instrument in its final form.

A chapter is devoted to electric-spark photography of sound waves. While it contains little that is novel, it is useful for the excellent photographs it shows. Prof. Miller assumes in his readers a knowledge of the refractive effects, on light, of local variations in the density of air. Perhaps had he begun with a few sentences explaining this to help those who are not physicists, and even a preliminary diagram to show, as in modern textbooks on sound, the wave from the nose of a bullet as the envelope of a series of circles with their centres in its wake, the non-expert would have been encouraged to pursue Part 2, the general outline of which, so clearly described, should have interest for him, despite its technicalities and mathematical equations (which he can skip).

Part 2 deals with a number of experiments on the pressures from gun-fire and on the velocity of sound, which were made possible by exceptional opportunities available during, and just after, the Great War, at the Sandy Hook Proving Ground. Perhaps the most interesting section here is that describing the propagation of explosive sounds through air. Starting with Riemann's formula for the velocity of explosive sound, Prof. Miller describes the experimental precautions by which he was able to take account of the variables affecting his results. He found that "Simple approximate calculations led to the surprising and disturbing result that on a line at right angles to the axis [of fire of the gun], the apparent velocity was sometimes less than normal". The observations he then made led to the view "that the virtual source of the sound, and the centre of the developing wave front in its beginnings, are in effect shot out of the gun, with a speed which may be in excess of that of the projectile itself". The value of these observations is enhanced by the descriptions of the apparatus used and the mathematical analysis of the results. The final pages of the book are devoted to various determinations of the velocity of sound, to which Prof. Miller's own work makes a useful contribution.

The volume will find a place, for future reference, on the book-shelves of all who are interested in the several aspects of the subjects of which it treats.

LL. S. L.

Towards a World Encyclopædia

Encyclopædia Britannica—Book of the Year 1938:
being a Survey of the Principal Persons, Events, and Developments in various Spheres of Knowledge and Affairs during the Year 1937. Pp. xviii+742. (London: Encyclopaedia Britannica Co., Ltd., 1938.) 45*s*.

THE "Encyclopædia Britannica", in common with other institutions of world-wide fame, changes its methods to suit the demands of a changing era. Time was, when a batch of supplementary volumes might be added to the old to make a new edition. So the ninth edition of 1875–1889, reinforced by a massive group of supplements, appeared as the tenth edition of 1902, and this, which was destined to endure until 1911, was replaced in that year by an entirely recast edition, the eleventh—an edition still held in high esteem by those who love the detailed and technical scholarship of the older editions. The twelfth and thirteenth editions were made by adding supplementary volumes to this eleventh edition, and the fourteenth edition of 1931 was almost entirely new, giving expression to a policy which departed from that of the older editions in favour of a rather more popular though not necessarily less scholarly outlook.

But the hurrying years of our generation do not permit of seven- or ten-year intervals between

successive editions, and the publishers of the "Encyclopædia", recognizing this, have produced what is to be the first of a series of year-books. The volume under review deals with the movements and events of the year 1937, and it may perhaps be regarded as a step towards the realization of the World Encyclopædia of Mr. H. G. Wells. We say this advisedly, for the volume does certainly fulfil some of the objects of that vastly greater scheme. It does not shirk the discussion of contemporary political and social questions of the highest import; it treats them, in general, in an objective and rational fashion; it gives up-to-date and quantitative political and social statistics; and in many instances, though not in so many as one could wish, it provides pointers to fuller sources of information.

In this volume, the first of an annual series, it is legitimate to expect that many of the articles should deal, not only with developments in 1937, but also with the happenings of the last half-dozen years. Indeed, in some articles, one might reasonably look for a brief, but complete in outline, exposition of the topic in hand. This expectation is, on occasion, realized. Thus the article "Communism" over the initials "E. B." is, as one might have expected it to be, a perfect thumb-nail sketch of the subject. The events of the civil war in Spain are outlined from the Spanish elections of February 1936. On the other hand, the story of the Abyssinian tragedy would seem to be completely inadequate, the events of 1937 being summed up in sixteen lines of text, and no attempt being made, under any obvious heading, to give even in bare outline, the course of the events that led up to the surrenders of the early months of 1937.

It is not easy to devise a fair test for the usefulness of a volume which covers such an immense range of topics, which deals with such vast masses of factual detail. It would be easy (and completely misleading) to put on record occasional instances where the information desired was not forthcoming. The most trustworthy test is to use the volume constantly over a period of some weeks and to note how frequently one is let down. This method has been tried with surprisingly good results. On matters of general interest such as the variation in income tax during the post-War period, the criminal statistics of the year 1937, the acreage under root crops, the statistics of rearmament, the Budget, broadcasting, progress in art, music and philosophy, in international trade and international law, detailed and clear information was at once forthcoming. This is also true of more obscure and detailed matters. Thus, to chronicle one example from a score or more of such samplings, information was sought concerning the membership of the communist parties in England and in France. The numbers were listed and easily run down (*c.* 10,000 and 280,000 respectively). Again, a remarkable change, of recent months, has occurred in the attitude of this party to the policy of a 'United Front', and the year-book, consulted on the matter, points to the reason for this change in a manifesto emanating from the Comintern (the Third, or Communist International) in which the masses in democratic and fascist countries are urged "to work for the establishment of a United Front of anti-fascist forces"! This is but one sample of the minute detail to which the articles condescend, and it speaks volumes for the high standard of the writing and the skill of the editing that so much detail may be filled in without blurring the larger outlines.

The scientific and educational articles do not call for detailed treatment. They are, in the main, written in simple language. No important recent developments are omitted, and advances in the applications of science are fully recorded and explained. Atomic physics; the latest discoveries in biochemistry and in cancer research; developments in power supply: improvements in public and private illumination and its measurement; the design of the latest giant telescope; it would be easy to draw up a list of articles dealing with advances in science, pure and applied, which should exceed this review in length, and would still form but a sample of the part of the volume devoted to matters of scientific interest.

It is an almost impossible task to sum up, in a few phrases which shall not be misleading, the contribution made to the welfare of our society by a massive year-book such as this. Its articles are full, critical and written in clear and non-technical language; they miss little of importance and chronicle many obscure and trivial events—trivial, that is, purely by comparison with some of the happenings of world importance which receive full consideration. War clouds may be gathering; the structure of civilized society may show ominous cracks and fissures; but these are no reasons why we should not interest ourselves in the latest developments in ballet music, the doings of the National Baseball Association, or the whereabouts of Inaccessible Island. Political events are treated in a liberal and objective spirit, though here and there, *rari nantes in gurgite vasto*, articles may be found written in such a spirit of caution as to result in a presentation of meagre, though accurate, detail; the index is a work of art which immensely reduces the labour of search; the production leaves nothing to be desired.

The book may fairly be classed among the indispensables, and one can heartily wish to it and to its successors a complete and unqualified success.

ALLAN FERGUSON.

Vergleichende Morphologie der höheren Pflanzen
Von Prof. Dr. Wilhelm Troll. Band 1: Vegetationsorgane. Teil 1, Lieferung 2. Pp. 173–508. (Berlin: Gebrüder Borntraeger, 1937.) 27 gold marks.

ON the first page of this second "Lieferung" of Part I of the first volume, in continuation of the introduction to the main heading, "The Construction of the Shoot and Shoot-systems", the author discusses the 'phyton-theory' of Schultz, Gaudichaud and Celakovsky, but rejects it as not taking account of the structure prevailing at the stem-apex.

Section I of the main thesis on shoot-construction deals with nodes and internodes. Section II treats of the shoot-axis and leaf. Genuine cases of *terminal* foliar organs exist, but they are regarded as derivative. A chapter is devoted to the cortication and alation of the stem by leaf-bases. Leafless shoots form the topic of another chapter, and the rhizophore of *Selaginella* is described and its morphological nature discussed. The author concludes that a comparative and experimental study of the problem shows that the rhizophore is decidedly a modified *stem*. The leafless shoots of Psilotales are described.

In Section III many pages are devoted to the "Phenomena of Lateral Symmetry in the Structure and Leaf-formation of Shoots". 'Flattened shoots' are described in detail. The phylloclades of *Asparagus*, *Ruscus*, etc., are regarded as of shoot nature.

The final section of this "Lieferung" is concerned with the large subject of branching. That of the Pteridophytes and Lycopsida is discussed. Considerable space is devoted to the Lepidophytes from the Coal-period. In particular, the *Stigmaria*-problem is fully dealt with. After a special comparison of *Stigmaria* with the mature and seedling structures of *Selaginella spinulosa* and its rhizophores, the author concludes that *Stigmaria* and the rhizophores of *Selaginella* may be regarded, not as a mere "parallel modification" as Scott stated, but as strictly homologous structures.

As in the first "Lieferung", so in this one, the subject-matter is illustrated throughout by very numerous and excellent figures and photographs.

W. C. W.

The Metabolism of the Frog's Heart
By A. J. Clark, M. G. Eggleton, P. Eggleton, R. Gaddie, C. P. Stewart. (Edinburgh Medical Monographs.) Pp. xii+308. (Edinburgh and London: Oliver and Boyd, 1938.) 15*s*. net.

THIS useful monograph contains a full and critical summary of recent work on the chemical processes in the frog's heart and their relation to muscular activity. So much of our knowledge of muscle physiology is based upon those peculiar and highly specialized organs, the muscles of the hind legs of the frog, that information from other sources is needed as a corrective to one-sided views.

On the whole, heart muscle seems to be a more generalized type of tissue than skeletal. As the authors point out, the frog's heart (and perhaps any heart) is not well adapted to correlating energy exchanges, expressed as heat, tension or work, with chemical processes. For this purpose a muscle with straight parallel fibres capable of developing high tensions is necessary. To compensate for these defects, the frog's heart is well suited to measuring the chemical processes themselves, though on account of its small size a very refined technique is needed. The development of this technique has been almost entirely the work of Prof. A. J. Clark and his colleagues at Edinburgh during the past ten years. They are also responsible for most of the results.

The subjects dealt with are as follow: the structure and chemical composition of the heart; oxygen usage and its relation to carbohydrate and non-carbohydrate metabolism; anærobic processes; phosphorus metabolism; the effects of asphyxia and certain depressants on the heart's activity. There follows a discussion of the way the heart's metabolism varies with changes in the electrical and mechanical responses, and of the light these processes throw on the fundamental nature of muscular activity. The last chapter gives a useful comparison of the frog's heart with other types of muscle. There is an appendix on methods.

Through the Great Arid Filter (Man's Drift to Europe)
By A. J. McInerny. Pp. 46. (Otley, Yorks: The Author, c/o Printerdom, 1938.) 2*s*.

MR. McINERNY here elaborates further and in some considerable detail his theory of the part played by the desert in the development of the more advanced races. It is a special adaptation of the more general theory of the influence of geographical environment in moulding man and his culture; but whereas it is most generally held that arable land is an essential condition of progress, the initial stages of cultivation being regarded as the first step towards the higher forms of civilization, the author on the contrary holds to 'thermal aridity' as the efficient cause. The stimulating effect of the solar energy and wide range of variation in temperature of the desert, it is maintained, has transformed non-progressive jungle man into the progressive white races of Europe. On this view, the long-headed races are a product of the desert belt extending from Africa to India, of which the Sahara is the most important section, and the broad- or round-heads emerge from the area of the Caspian. The 'Brown Race', cutting across this desert belt, represents an intermediate stage in the development. In the Far East the Chinese are regarded as the equivalent of the Egyptians, their further development having been arrested for reasons which are stated, while the Japanese represent the Europeans, the efficient cause here being the Gobi Desert.

Mr. McInerny has applied his theory to racial distributions, past and present, with no little ingenuity, and makes it something more than plausible; but until the mental processes underlying progress are more fully understood, as well as the effect of the reactions to 'thermal aridity', it cannot be accepted hastily as proved. In the cultural context, the hypothesis seems to postulate a stimulus which at times is rather remote.

A Short History of Naval and Marine Engineering
By Eng.-Capt. Edgar C. Smith. Pp. xix+376+16 plates. (Cambridge: At the University Press, 1938.) 18*s.* net.

AS the editor of *Engineering* points out in his foreword, most of the material in this work has appeared in the pages of that journal, but its re-issue in book form is more than justified. The author, who is now president of the Newcomen Society, has traced the development of marine engineering from the early reciprocating engine to the turbine and diesel, and from the rectangular flue boiler working at less than 5 lb./in.² to the forced circulation boiler of to-day. So much of the corresponding development in the field of naval architecture as is required to make a complete picture is also described.

While not in any way a text-book in the conventional sense, a perusal of this book should be as inspiring to the student as it should be attractive to the non-technical reader, to whom more especially the accounts of early voyages of steam vessels will appeal. As a work of reference, it will have lasting value; the index is excellent, and an extensive bibliography is scattered through the text.

In a chapter on the turbine, an intensely interesting light is thrown on the genius of Watt. The author tells us that in a letter full of calculations to Boulton in 1784, after hearing of the re-invention by Kempelen of what was in effect Hero's reaction turbine, Watt wrote with uncanny vision: "So that you see the whole success of the machine depends on the possibility of prodigous velocities . . . in short without god makes it possible for things to move 1000 feet pr' [i.e., per second] it can not do much harm".

A plea must be made to the author to apply in the next edition the correct epithet to ship-model testing tanks. That of Froude the elder may well have been experimental, but to-day, in an experiment tank, it is only the models which are experimental. G. V. B.

Elektrotechnische Berichte
unter Mitwirkung des Verbandes Deutscher Elektrotechniker e.V., herausgegeben von Franz Moeller VDE, Berlin. Band 4, Heft 6, 15 Januar, 1938. 6 Bde. yearly. (Berlin: J. Springer.) 48 gold marks each.

THE advent of a major abstracting journal is an event of considerable importance in the scientific world. The subject of this one is electrical engineering. Existing periodicals devoted to abstracting, or indexing, electrotechnical literature are thirteen in number. If we except the *Deutches Rundfunkschriftum* and the *Wireless Engineer*, which include a number of articles of less importance, hitherto no journal has included so many abstracts on electrical engineering as *Science Abstracts* B, and this contains only some three thousand five hundred in a year.

The new journal appears in fortnightly parts, forming six complete volumes annually, and comprising altogether a total of seven thousand abstracts, of which from four thousand to four thousand five hundred are taken from purely electrotechnical periodicals, while the remainder come from journals dealing with general science or cognate subjects, or represent notices of books. The length of the abstracts varies considerably, apparently being adjusted according to the values at which the articles are appraised.

The titles of the articles are quoted, as they should be, in the language of the original, and are also translated into German. The fact that the abstracts are in German is a drawback to English readers. But this difficulty is overcome to a large extent by classifying each abstract minutely by means of the decimal classification, several numbers being added to an abstract if the subject requires. This enables the abstracts of papers on any particular subject to be picked out with the greatest of ease, irrespective of language.

In spite of its high price, this new periodical is likely to become a standard abstracting journal in its subject.

Solvents
By Dr. Thos. H. Durrans. (Monographs on Applied Chemistry, under the Editorship of Dr. E. Howard Tripp, vol. 4.) Fourth Revised and Enlarged Edition. Pp. xvii+238. (London: Chapman and Hall, Ltd., 1938.) 15*s.* net.

THERE is a plethora of books to-day dealing with one aspect or another of the use of organic solvents in industrial operations. Almost the earliest of these was that of Dr. Durrans; its utility is made clear by the fact that a fourth edition is now required. The preface speaks of a complete revision and amplification and an attempt to make it of use to a somewhat wider industrial field.

In particular, progress has been made in the field of plasticizing solvents. The appendix giving the probable composition corresponding to the numerous trade names for solvents has been enlarged, also the useful table indicating the solubility of sundry resins and varnishes in the solvents.

The book retains its former general character and will be as heretofore indispensable to anyone who has to do with solvents: it is most thorough in every detail.

Die Fermente und ihre Wirkungen
Von Prof. Dr. Carl Oppenheimer. Supplement, Lief. 7 (Band 2, Specieller Teil, Haupt-Teil 16, 17). Pp. 943–1102. 10 fl. Supplement, Lief. 8 (Band 2, Specieller Teil, Haupt-Teil 17). Pp. 1103–1262. 10 fl. (Den Haag: Dr. W. Junk, 1937.)

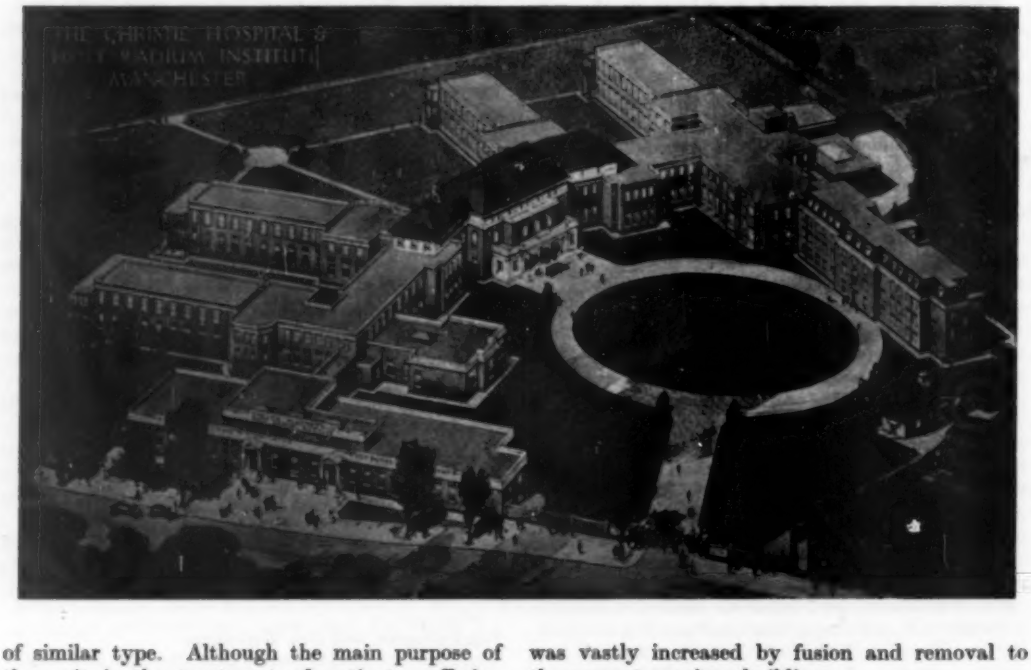
THIS supplement progresses towards its completion which, at the time of writing Part 8, is put down as requiring another six months. The two parts now received deal with thrombase, the fibrin ferment of the blood, and begin the fourth main section entitled "Desmolases". The theories of the oxidation-reduction chain of reactions and the well-known catalysts, including cellular fermentation, are described.

As these matters are in the forefront of interest at the present time, workers will appreciate having the literature summary brought up to date. The treatment follows familiar lines.

The Christie Hospital and Holt Radium Institute, Manchester

SITUATED in the outskirts of Manchester, the Christie Hospital and Holt Radium Institute, which was opened in 1933, presents certain features interesting not only from the medical aspect, but also from the point of view of organization of radio-therapy for malignant disease.

The present institution (Fig. 1.) is the result of the fusion of two much older hospitals; it is one of the largest units of its kind in Europe, and is only exceeded in size by a few American institutions a long start over many other centres where organization was at first more haphazard. The Christie Cancer Hospital had a longer history. It developed gradually from a cancer home for incurables to an active unit concerned with the surgical treatment of malignant diseases. It then became apparent that expansion was essential, and in 1933, under the chairmanship of F. P. Nathan, deputy-lieutenant of the County of Lancashire, the scope of the work of both units



of similar type. Although the main purpose of the unit is the treatment of patients suffering from malignant disease, much experimental work is done concomitantly to advance the scientific practice of radio-therapy, and to study the action of radiation on living tissue.

Little need be said about the history of the Institute. The old Manchester Radium Institute founded in 1915 within the confines of the Manchester Royal Infirmary took independent existence in 1921, owing to the generosity and foresight of Sir Edward Holt, at one time lord mayor and a freeman of Manchester. From the beginning, this Institute, under the guidance of the first director, Dr. A. H. Burrows, maintained the principle that radiation therapy should be centralized as an independent specialty. In consequence, Manchester had was vastly increased by fusion and removal to the present spacious buildings.

More than six grams of radium are held at present; part of this is owned, and part is loaned from the National Radium Commission. The bulk of the radium is in the form of needles and tubes, with in addition just over one gram in solution for the preparation of radon. With this amount of radium in use, extensive protective devices for the health of workers have had to be developed. From the time the radium leaves the safe, which has protecting walls of 6 in. of lead, until the moment of insertion into the patient, the radium needles remain encased in lead, although in the interval they have been threaded, prepared, sterilized and transported from room to room.

Speaking generally, present-day radium methods consist either of implantation of radium contained in hollow platinum needles into and around malignant growths, or of the application of radium, suitably mounted, superficially to such growths. The former method, implantation technique, is analogous to surgical procedures and requires asepsis and anaesthetics. On the other hand, for radium used superficially, a special laboratory has been developed which combines to some extent the features of a dental workshop with those of a sculptor's studio. Here plaster casts of the tumour-bearing area are made and appliances modelled on these to carry the radium and to fit each patient exactly.

The X-ray Department consists at the moment of a suite of four rooms, each containing an X-ray tube energized at 250 kilovolts. These plants were designed and built by the Research Department of Metropolitan-Vickers Electrical Co., Ltd., and constituted, when first designed, a new departure in the application to medical work of continuously evacuated X-ray tubes and rectifying valves. At the present time, there is being installed a 500 kilovolt unit of similar design. The units are operated with the anti-cathode at ground potential; two advantages accrue from this. First there is the ability to use direct water-cooling of the target from the mains, and second there is the advantage that the high tension is completely removed from the treatment room. Rotation of the head of the tube carrying the target (anti-cathode) is achieved through a gear-driven joint between optically flat steel surfaces. For actual treatment, the emergent beam is defined by applicators which also rotate round the tube, interlocked with the rotation of the target.

The linkage between power units and tubes is of some interest. There are in all four 250 kv. tubes, and two 250 kv. generators. The design is such that each generator can be connected to any or all of the tubes, through one or other of a pair of high-tension leads. To achieve this, each tube has a high-tension change-over switch through which it can be linked to either generator or to earth. The main high-tension leads occupy a special overhead duct behind the treatment rooms. Normal running is usually two tubes to each generator, but there are no fewer than seventy different combinations available for various contingencies. The installation was designed therefore in such a way that any one plant or any one tube could be isolated and repaired in the event of breakdown with the absolute minimum of interference with the general running of the Department.

The radiological staff consists of a group of whole-time therapists, and two physicists. The medical and surgical work is dependent on an honorary visiting staff. There are also various auxiliary services. The radiological work is divided amongst the team in such a way that each therapist, in addition to general work, takes over a special small field in which he can become expert and in which he can develop new techniques.

During the last five years, this team has made a number of useful contributions to the science of

AREAS FOR WHICH RADIUM THERAPY SERVICE IS PROVIDED. FIGURES INDICATE NUMBER OF PATIENTS REFERRED FROM EACH TOWN IN 1937. HOSPITALS RECEIVING RADIUM SERVICE, ○. INSET MAP: DETAILS OF THE MANCHESTER AND SALFORD AREA.

radio-therapy, particularly in relation to the development of accurate systems of dosage.

To the physically minded, it may seem almost incredible that radium therapy should have been practised until recently on no sound quantitative basis; yet such was the case. Radium dosage was described in terms of the amount of radium used, and for accurate information was relatively meaningless. It was obviously essential to have a unit which states the amount of radiation absorbed at any point, be it in tumour growth or in skin. Some years ago the Manchester School evolved a clinically practical unit of measurement of gamma radiation, selecting for this the roentgen, the internationally accepted unit of X-radiation. This choice was made in order to bring these two essentially similar therapeutic agents to comparable terms. The suitability of the roentgen as a unit of gamma ray therapy was recognized at the recent International Congress of Radiology.

In X-ray therapy also, treatment methods have been open to severe criticism, in that they consisted of a mass of empirical techniques depending on a variety of variable factors, such as so-called 'air dosage', skin tolerance doses, and so forth. The Manchester School has contributed to the clarification of the situation by the development of methods of treatment in terms of accurately measured tumour dosage.

There are three fields in which this knowledge of dosage has proved of immense value. First, information can now be obtained on the tolerance of normal tissue, especially skin, to the effects of radiation, and the importance of the 'time factor' in that respect can be studied. Next, it is at last becoming possible to group tumour growths relatively accurately in accordance with their particular radiosensitivity. Lastly, the value of accurate measurement in the experimental work of the new Research Laboratories of the Institute is inestimable. Research on the biological effects of radiation covers an immense field, but as C. M. Scott has pointed out, the value of much of it has until now been entirely vitiated by the absence of a quantitative outlook.

TABLE 1. NUMBER OF NEW PATIENTS SEEN IN 1936.

Mouth	349
Skin	394
Uterus	200
Breast	298
Pharynx and Larynx	103
Bladder and Rectum	81
Œsophagus and Lung	59
Various Glands	88
Lip	48
Genitalia	51
Other malignancy	160
	1,831
Other conditions—non-malignant	382
	2,213

Cancer is still, after war and the toll of the roads, one of civilized man's most serious menaces, and an inevitable question in considering the work of an institute such as this is as to the results of treatment, and as to whether real advance is being achieved. A very brief review is given, therefore, of the part which radiation plays in the treatment of malignant disease. The scope of radiation therapy can be summarized by an analysis of the types of cases treated at the Institute (Table 1).

Of these numbers, how many are likely to be cured? Table 2 indicates in round figures the achievement of the methods employed in 1932 as assessed to-day (non-malignant group excluded).

TABLE 2. NET FIVE-YEAR SURVIVAL RATE OF ALL CASES TREATED BY RADIATION, INCLUDING ADVANCED CASES.

All types of Malignant Disease (in proportions of Table 1)	40 per cent
Mouth only	30 "
Cervix uteri only	30 "
Skin only	85 "

It will be observed that the figures in Table 2 include the survival rate of all cases treated, whether in the early or advanced stages. A more striking illustration of what can be achieved by radiation therapy is seen in Table 3, from which the very advanced cases have been excluded—a table which at the same time points to the importance of early treatment of malignant disease.

TABLE 3. NET FIVE-YEAR SURVIVAL RATE, EXCLUDING ADVANCED CASES.

All types of Malignant Disease (in proportions of Table 1)	60 per cent
Mouth only	45 "
Cervix uteri only	50 "
Skin only	90 "

Summarizing, it may be said that, while malignant disease remains one of the most serious of diseases, nevertheless something quite definite can be achieved by the methods employed in an institute such as the one under description. The number of patients treated now yearly exceeds 2,000. As estimated from the work of previous years, at least 50 per cent of these will certainly be alive and well three years after, 40 per cent five years after, and unlikely to develop recurrence of their tumour. Unfortunately, many patients at the time they are first seen can only be assisted in a palliative way, the disease having been allowed to progress too far. If we consider the value of treatment in relation only to the earlier lesions, then we find that some 60 per cent of all cases may be expected to be alive and well in five years' time.

As will be seen from Table 1, radio-therapy is at present a method of treatment only applicable to a proportion of all cancer cases, and the number of such cases in even a large population is relatively low. In a population of 100,000 there are probably between 50 and 60 cases of cancer per annum which should be treated by radio-therapy. On this basis, a unit with extensive equipment and a considerable medical staff must serve a very wide area to reach its highest effectiveness. It is

estimated that the 2,000 new cases seen annually represents the sifting of cases from a population of approximately 6,000,000. The proportion of cases sent in for treatment from each district tends to vary inversely with the distance from the centre. Thus in the immediate local area (Manchester, Salford and Stockport), practically all cases come for consideration regarding treatment, while in the periphery of the zone served, a smaller fraction is referred unless steps are taken to increase it. This situation is demonstrated by Table 4, which also shows the results of the measures adopted by the Institute to reach patients in the surrounding area.

TABLE 4.

Year	No. of patients referred from civic area*. (Population 1,039,740.)	No. referred per 100,000 population.	No. of patients referred from immediately surrounding area†. (Population 1,663,860.)	No. referred per 100,000 population.
1931	465	44	362	21
1932	434	41	365	21
1933	474	45	462	27
1934	496	47	736	44
1935	572	55	794	49
Increase over 5 years—25 per cent			Increase over 5 years—133 per cent	

* Civic area includes the cities of Manchester and Salford.

† Surrounding area is the south-east quarter of Lancashire (excluding Manchester civic area), bounded by the line, Cheshire border, Warrington (exclusive), Preston (inclusive), Yorkshire border.

This improvement in the availability of treatment to patients has been achieved by the development in connexion with the Institute of clinics not only in Manchester in its own hospitals, but also in a large number of voluntary hospitals of towns in the area served (see accompanying map). Treatment clinics are also held, but in a more limited number of such outside hospitals. There the simpler cases are dealt with, while those more complex are brought for treatment to the central unit where the facilities are greater. In the same way the Institute has entered into agreements with City and County Health Authorities by which cases of cancer in their control are seen, and if suitable for radio-therapy are treated.

In conclusion, there are many indications that as national organization for the treatment of cancer evolves, it may be necessary to develop it along lines similar to those now accepted for the treatment of tuberculosis, that is, along modified State service lines. In this case, the unit and the organization described above may prove to have been in some respects a prototype.

Recent Developments in the Geology of the U.S.S.R.

By Prof. N. N. Gornostayev*

THE successive Five Year Plans in the Soviet Union have been accompanied by a vigorous development of geological science, and new mineral wealth is being discovered almost daily by the 6,000 geologists who are employed in prospecting over the whole vast area of the U.S.S.R. Soviet deposits of oil, coal, peat, iron, manganese, gold, potash salts and phosphates, are among the largest in the world.

In 1913 the known coal deposits of Russia comprised but 3·2 per cent of the world's resources, as estimated by the Twelfth International Geological Congress. At the Seventeenth Congress held in Moscow last year, the estimated coal resources of the Soviet Union were found to be seven times greater than in 1913, comprising 1,654,361 million tons, or nearly 21 per cent of the world's coal reserves.

In addition to the Donetz Basin, which yielded 87 per cent of the coal mined in Russia in 1913, large coal deposits have been discovered in Kazakhstan, Siberia and the Far East. The coal deposits of European Russia now comprise only 9·1 per cent of the total resources of the U.S.S.R. This more uniform distribution of coal resources has made widespread industrialization much more feasible.

The iron ore deposits of the Soviet Union are now known to be five and a half times greater than was estimated in 1913. The reserves of oil are fourteen times greater than was estimated in 1905. Oil fields have been found along the entire Urals range, and prospecting is in progress on the vast Siberian plains. It is possible that Siberia will be found to contain some of the richest oil deposits in the world. Incidentally, Siberian oil is the oldest known, as it is found in Cambrian formations.

It is now established that about 83 per cent of the world's known resources of potash are concentrated in the U.S.S.R., and these resources are being steadily augmented by new discoveries. More than 73 per cent of the world's manganese ore reserves are contained within the Soviet Union. The huge deposits of apatite found in the Kola Peninsula have doubled the world's resources of phosphates.

* Revised and abridged by Dr. G. W. Tyrrell from an article entitled "Soviet Geology" received from the Soviet Union Year Book Press Service.

The U.S.S.R. holds second world place in respect of gold output. The gold industry, which formerly employed the most primitive methods, has now been greatly modernized. Large nuggets are often obtained, as, for example, one of 32 kgm. which was found in the Miass (Urals) gold field.

The desolate region of Kazakhstan, the roving ground of nomadic tribes, is now the main Soviet source of supply of non-ferrous metals, especially copper, zinc and lead, and has far outstripped the Urals, the former source of these metals. Until recently the U.S.S.R. was thought to be lacking in boron, but huge deposits of boracic salts have been found in the region around Lake Inder in north-west Kazakhstan.

The geological structure of the U.S.S.R. is exceedingly varied. On its territory are huge mountain folds which have risen on the sites of former sea depressions filled with soft clays, sands and limestones (for example, the Caucasus). There are mountains which are fragments of ancient rocks split into uneven blocks which have moved upward or downward (for example, the Tian-Shan, Altai, etc.). There are deep depressions such as Lake Baikal (the largest freshwater lake in the world, more than 1520 m. deep), and the Black and Caspian Seas, formed in geologically recent times.

The wide plains of West Siberia are now known to cover the greater part of the former range of the Urals. The Urals of to-day represent merely the western margin of this great Hercynian range and, moreover, were elevated in comparatively recent geological times.

Formerly, the Crimean mountain range was as extensive as the Caucasian, but, broken by enormous faults, it sank, and now lies beneath the floor of the Black Sea at a depth of more than 2000 m. The Crimean mountains of to-day are merely a remnant of the northern part of the ancient range.

Some Western geologists have maintained that oceanic depressions have always existed, and that the Pacific Ocean constitutes the 'scar' caused by the parting of the moon from the earth. Recent work by Soviet geologists has shown, however, that the northern part of the Pacific, until comparatively recent times, was a vast continent with mountain chains, hills, plains and volcanoes, stretching between Siberia and North America.

The variety and complexity of geological structures in the U.S.S.R. explain the variety of igneous rocks within its territories. Practically all known varieties of igneous rocks have been found. The largest developments of nepheline-rich igneous rocks in the world, with many rare and rare-earth minerals, and enormous deposits of apatite, have long been known to occur within the Kola Peninsula. Entire mountains of sodic sanidinites, hitherto known only in the form of separate lumps in volcanic ejecta, have been found in Kazakhstan.

Study of the mineral springs of the U.S.S.R. has made it possible considerably to extend the health resorts, not only in the world-famed Caucasian region, which has been greatly enlarged, but also in many other parts of the U.S.S.R., including the Trans-Baikal, Yakutia and the Far East. In the vicinity of Moscow itself mineral waters containing bromine, radium and other valuable therapeutic substances have been found. Geochemistry is flourishing, and discoveries of many valuable minerals are largely the result of geochemical prognoses, which are being made with increasing accuracy and confidence.

The study of marl, alluvium, gravels, sands, clays, etc., is making rapid headway, particularly in connexion with the building of large structures and hydro-technical projects. Data on engineering geology and hydro-geology obtained during the construction of the Palace of Soviets, the Moscow Metro, the White Sea–Baltic Canal, the Moscow–Volga Canal, and other projects, have made it possible to plan more confidently large-scale undertakings such as the Volga Dam and the irrigation of the arid steppes of the Trans-Volga region.

The development of life on the earth began with the appearance of primitive plant life and later of animal life. Until recently, geologists have traced the evolution of life more or less systematically from the Cambrian Period. Of Pre-Cambrian formations it was possible to judge only from accidental and isolated discoveries of fossils. But in Siberia fossil remains of Cambrian and Pre-Cambrian age have recently been found in great abundance, and the study of these remains is one of the most fascinating problems of Soviet palæontology. It is possible that ancient Asia may prove to be the cradle of life on the earth, as it was of the higher forms of animal life, mammals, and even of man.

The remains of mammoths have been found in many places, but only in the north of Siberia are complete well-preserved carcasses of these animals, and of their contemporaries, the long-haired rhinoceroses, found in the natural cold storage of frozen swamps. A special expedition has been organized to study these remains in their natural habitat. Remains of the mastodon, an even more ancient member of the elephant family, have been unearthed in the Kuban in North Caucasus. The tusks of this species were spoon-shaped for the purpose of scooping food from silt and muddy water.

The study of fossil animal and plant life in the U.S.S.R. promises to add much that is new to research on the evolution of organisms under various external conditions.

Obituary Notices

Dr. Géza de Horváth

IN these days of narrow specialization it is refreshing to look back on a generation of workers who, by their extensive biological knowledge and literary erudition, were able to deal satisfactorily with the multitude of new forms of life which improvement in transport and the rapid exploitation of the world during the latter half of the last century, were bringing to the European museums.

With the death of Dr. Géza de Horváth at Budapest on September 8, 1937, in his ninetieth year, entomology has lost one of the last of such men. When Horváth was a young man, Prof. Carl Stål, working in the Swedish State Museum at Stockholm, was busy founding the modern classification of the Hemiptera, and it was Horváth and his famous Finnish contemporaries Prof. O. M. Reuter and Dr. E. E. Bergroth, more than any others, who were destined to elaborate this system and build up from it our present knowledge of the systematics of the order.

Horváth was born on November 23, 1847, at Csécs in Northern Hungary. He was educated at the Kassa Gymnasium, where he was a pupil of the celebrated Prof. Jeitteles, and from there went up to the University of Vienna to study medicine. After graduating, he at first worked as an assistant in the Hungarian National Museum, but after about eighteen months he left the Museum to take up a medical practice in the provinces.

In 1880 Horváth was called upon to organize a *Phylloxera* experiment station at Budapest and acted for some time as its director. With the solving of the *Phylloxera* problem throughout Europe, the work of this station was directed towards the control of other injurious insects, and in 1890 it was renamed the Institute of Experimental Entomology. With the help of Jablonowski, such pests as the Moroccan locust, the nun moth, the hessian fly, the frit-fly, the grain sawfly, the grain aphis, clover weevils and the sugar-beet beetle were satisfactorily investigated.

Horváth returned to the National Museum in 1895 and worked as head of the Department of Zoology. Here as a specialist on the Hemiptera, he acquired a world-wide reputation. His systematic papers alone run into several hundreds. He made various scientific expeditions abroad and was a member of the permanent committee of the International Congress of Zoology, and of the International Committee of Zoological Nomenclature. In this capacity he visited the United States in 1907. Horváth was elected a member of the Hungarian Academy and was an honorary member of several foreign scientific societies. In 1927 he was elected president of the tenth International Zoological Congress held at Budapest. He retired from the directorship of the Museum in 1921, but continued to work on the Hemiptera until his death. W. E. CHINA.

Sir Edward Denham, G.C.M.G., K.B.E.

WE regret to record the death of Sir Edward Denham, distinguished Colonial administrator and captain-general of Jamaica, which took place on June 2 at the age of sixty-one years.

Edward Brandis Denham was born in 1876, the son of the late Mr. Charles Denham of Sydney. He was educated at Malvern and Merton College, Oxford, and was appointed to a cadetship in Ceylon in 1889 after competitive examination. He had risen in the Colonial service to the rank of principal colonial secretary of Ceylon and colonial secretary of Mauritius, when in 1923 he was appointed Colonial Secretary of Kenya at a time when the present issue of the famous White Paper, laying down the principle of the paramountcy of native interests, was bringing about important changes in the attitude of the administration in dealing with various native questions. The communal system of representation, giving separate representation to Europeans, Indians, Arabs and natives was then being introduced, and in 1924 a measure of self-government was granted to the native tribal councils. These changes threw a heavy burden on Denham's shoulders, which was still further increased when, in 1925, the death of the governor, Sir Robert Coryndon, required him to take up the duties of acting governor, an office which he held until the arival of Sir Edward Grigg as Coryndon's successor in October 1925.

While acting governor, Denham made a tour of the Nyanza and Kikuyu provinces and the Kitui district, the most thickly populated parts of the Colony, with the view of studying the changing mentality of the native in contact with Europeans and their civilization. The results of his observation were embodied in an original and extremely valuable report, which was published as a Blue Book. Especially noteworthy were his remarks on the working of the recently established native councils.

In 1928 Denham was promoted to be governor of Gambia, and in 1930 he was transferred to British Guiana, where he did much valuable work in the development of the resources of the Colony. His appointment as captain-general of Jamaica was made in 1934. His successful efforts in social and economic reform, and the part he played in the recent troubled conditions make his premature death an irreparable loss to the island and to the Empire.

WE regret to announce the following deaths:

Dr. Ch. E. Guillaume, formerly director of the Bureau International des Poids et Mesures, aged seventy-seven years.

Prof. Rudolf Vondráček, professor of fuel technology and metallurgy in the Brno Technical College, on June 12, aged fifty-seven years.

News and Views

Prof. Georges Urbain

ON June 10, a meeting was held in Paris to mark the fortieth anniversary of the first scientific publication of Prof. Georges Urbain, the distinguished French chemist, member of the Institut de France and director of the Institute of Chemistry in Paris. A committee under the chairmanship of Prof. Jean Perrin organized a meeting at the Maison de la Chimie, where Prof. Urbain was heartily greeted by his colleagues, pupils and friends. Prof. Urbain's name is best known in connexion with his work on the rare earths and with the elements lutecium and celtium or hafnium; but the wide field of his other achievements in the fields of phosphorescence, spectrochemistry and theory of valency, was indicated in a most interesting address by Prof. Lebeau, an old school-friend of Prof. Urbain. Prof. J. Perrin and Prof. P. Langevin in their speeches pointed out that Prof. Urbain was first initiated into chemistry by his father, a teacher in chemistry, and that he continued his studies at the Ecole de Physique et Chemie, where Pierre Curie was a laboratory assistant, scarcely much older than the young and talented student. Hard work in pure science did not prevent Prof. Urbain from developing his gifts in art, for he is a composer of music and excels in sculpture. Several of his musical compositions for piano and organ, as well as for piano and a quartet of string instruments, were produced before the audience. A portrait of Prof. Urbain was made for the occasion by the sculptor Aronson, but several of Prof. Urbain's colleagues have had the pleasure of having their effigies made by the great man of science himself.

Dr. A. R. Todd

DR. A. R. TODD, who has been appointed Sir Samuel Hall professor of chemistry and director of the Chemical Laboratories in the University of Manchester (see p. 1153), graduated in 1928 with first-class honours in chemistry in the University of Glasgow, where he won the Black Medal, the Roger Muirhead Prize and the Alexander Donaldson Scholarship. From 1928 until 1931 he was a Carnegie Research Scholar, working first at Glasgow under Prof. T. S. Patterson and later in Frankfort-on-Main under Prof. Borsche. Afterwards, as 1851 Exhibition Student, he worked for three years under Prof. R. Robinson at Oxford. In 1934 he became assistant to Prof. G. Barger in Edinburgh, where he held a Beit Memorial Medical Research Fellowship. In 1936 he was awarded the Meldola Medal, and in the same year he joined the Lister Institute as assistant in the biochemical department. Dr. Todd has published some thirty papers in chemical journals dealing with work on rotatory dispersion and the Walden inversion, the structure of bile acids, anthocyanin pigments, the chemistry of vitamins B_1 and E and other biochemical subjects. He enters on his new appointment at the end of September of this year.

Tercentenary of the Birth of Prof. James Gregory

THE University of St. Andrews will commemorate on July 5 the three hundredth anniversary of the birth of James Gregory, professor of mathematics in the University from 1668 until 1674. The actual date of his birth at Drumoak, twelve miles from Aberdeen, appears to have been November 6, 1638, but the mathematical colloquium to be held in St. Andrews in July affords a suitable opportunity for this celebration. An address on Gregory and his work will be delivered in the Upper Library Hall, where his meridian line was traced on the floor, followed by a graduation ceremonial at which honorary degrees will be conferred on distinguished representatives. On the previous day, the Royal Society of Edinburgh is holding a meeting at which papers will be read on the mathematical and astronomical work of the inventor of the Gregorian telescope, who died in that city in October 1675 shortly after his transference to the chair of mathematics in the University of Edinburgh.

Charles Hilton Fagge (1838-1883)

THIS distinguished London physician was born on June 30, 1838, at Hythe in Kent, where his family had been in practice for two generations, and was the eldest of three brothers who joined the medical profession. He was educated at Guy's Hospital, to which he was appointed assistant physician with charge of the skin department in 1867, six years after qualification, and full physician in 1880 in succession to Dr. Habershon. He was also for many years curator of the museum, for which he compiled a catalogue of the models of the diseases of the skin in 1876. His literary output was considerable. His most notable papers were the articles on "Diseases of the Valves of the Heart" contributed to Russell Reynold's "System of Medicine" and those on "Sporadic Cretinism", "A Line on the Gums Characteristic of Lead Poisoning", and the "Probable Cause of Lead Colic" in the *Medico-Chirurgical Transactions*. To *Guy's Hospital Reports*, of which he was editor for some five years, he contributed a classical paper on "Acute Dilatation of the Stomach" in 1873, in addition to other articles. In 1866–68, in collaboration with J. H. Pye-Smith, he translated and edited for the New Sydenham Society two volumes of Hebra's "Diseases of the Skin", the translation of the remaining five being the work of Mr. Waren Tay. His work on the "Principles and Practice of Medicine", on which he had been engaged for ten years at the time of his death, was completed and edited by Pye-Smith. The cause of his death

on November 19, 1883, at the early age of forty-five years was aneurysm of the aorta, the existence of which in his own person he had discovered about eighteen months previously while demonstrating the use of the binaural stethoscope. He nevertheless preferred to die in harness, a decision which met with the approval of Osler, among others.

A New Treatment of Pneumonia

SYNTHETIC compounds possessing specific curative effects in various infections—'chemotherapeutic agents' as they are termed—have long been sought for, though without much success, at least in bacterial infections. Three years ago, 'Prontosil', a sulphonamide compound, proved valuable in the treatment of streptococcal infections, such as puerperal fever. Quite recently, L. E. H. Whitby, investigating experimentally a number of synthetic compounds, found that one of them, 'M. & B. 693', had a marked specific effect upon the pneumococcus, the microbe of human pneumonia, almost complete protection being afforded against Types i, vii and viii pneumococcus infections, and a high degree of protection against Types ii, iii and v (*Lancet*, 1, No. 22, 1210; May 28, 1938). Encouraging clinical results in cases of pneumonia in man were reported by Evans and Gaisford (*Lancet*, 1, No. 23, 1305; June 4, 1938), and Telling and Oliver now give details of another case treated with this agent (*Lancet*, 1, No. 25, 1391; June 18, 1938). The patient, an old lady, was critically ill with pneumonia, pneumococcus Type iii being recovered from the sputum. After four days' treatment with the drug, recovery commenced and was finally complete. The observation was made that, in the course of treatment, the capsule which surrounds the pneumococcus became lost, and other changes in the organism were apparent. 'M. & B. 693', chemically, is 2-(*p*-aminobenzenesulphonamido) pyridine.

Organization of Archæological Research in India

As was pointed out recently in these columns (see NATURE, May 28, p. 965) little advantage has been taken of the facilities for archæological exploration offered some years ago by the Government of India to bodies from outside the country, nor, if Dr. E. Mackay's excavations be excepted, has a serious and systematic attempt been made on any adequate scale to follow up the discovery of the now famous early civilization of the Indus Valley. An indication that a forward policy is now contemplated is afforded by an announcement of the India Office that Sir Leonard Woolley has accepted the invitation of the Government of India to visit the country next winter before proceeding to Syria to resume his excavations in the spring of 1939. The object of the invitation is to secure his advice in regard to a programme of archæological work. Among the matters upon which it is understood that Sir Leonard will be consulted are, first, the areas which are to be regarded as most promising for future excavation; secondly, the best methods and agencies to achieve the speedy and fruitful development of exploration activities, not only under Government auspices but also by non-official bodies, such as universities and learned societies; and last, the best method of training, or selecting, officers for exploration work, including such points as the most suitable age for recruitment. Since the control of the Archæological Survey has passed into Indian hands, much excellent work has been done, more especially in those departments dealing with the growth of Indian civilization at periods with which her countrymen perhaps are more familiar and more competent to speak than 'foreigners'. The archæology of India is a subject for which her native students have shown both enthusiasm and aptitude; but they have had little opportunity to acquire the breadth of outlook which the study of the pre- and protohistory of their own country demands. The determination to seek outside advice and the choice of an adviser are wise steps, from which archæological studies throughout the world may expect to reap considerable benefit.

Peoples of Ancient Syria

EVER since the recognition of Sumerian influence in the Indus valley through discoveries in the excavation of Mohenjodaro and Harappa, archæological investigation has added continuously to the evidence of the remarkable, and it may be said, unexpected degree and geographical extent of the contacts and movements of cultures and peoples even in the early stages of the development of civilized society. Now Mr. Sidney Smith, in a communication to *The Times* of June 16, indicates how a preliminary examination of the tablets from the Palace excavated by Sir Leonard Woolley at Atchana affords evidence of the extremely mixed character of the population of Syria in the fifteenth century B.C. In ancient times, it would appear, the site of Atchana was known as Alalakh. It was the capital of the country, Mukish-khe, mentioned in Hittite and Egyptian records. It was a vassal State of the kingdom of Mitanni, as appears from a tablet recording an attempt to establish citizenship of a Mitannian province, brought before the king of that people about 1450 B.C. by a subject of Niqmepa, ruler of Mukish-khe. The documents which have been found at Atchana, Mr. Smith states, concern the status of certain citizens, and are in the Akkadian language. From the names recorded it is possible to deduce that the population contained a considerable proportion of Babylonians and of Khurrians, an indigenous people in Mitanni, but spread over a considerable area extending from Kirkuk, east of the Tigris, to northern Palestine, and of whose existence no knowledge survived prior to modern excavation. Niqmepa may be a Khurrian name, but his son's name is Babylonian. This, Mr. Smith points out, is merely another phenomenon of a mixed civilization, in which the predominant elements were Babylonian, apart from local law and administration. He goes on to say that the inscribed seal, to which Sir Leonard Woolley referred in his report, is no proof of Hittite conquest. The language of the Hittite hieroglyphs is not Hittite, though it may be Indo-European. The seal is, therefore, merely further proof of the mixed character of the population.

Patents, Designs and Trade Marks

THE fifty-fifth report of the Comptroller-General of Patents, Designs and Trade Marks presents, as usual, a solid mass of information about the volume of business handled during 1937 in the Patent Office (Patents, Designs, and Trade Marks. Fifty-fifth Report of the Comptroller-General of Patents, Designs, and Trade Marks, with Appendices, for the Year 1937. Pp. 25. London: H.M. Stationery Office. 6*d*. net). Applications for patents, which should reflect the inventive activity of the country, went over the 35,000 mark during the year, and the work of the 821 members of the staff resulted in a surplus of close on £300,000. Two pages of the report are devoted to an account of the trend of invention to-day. Synthetic drugs, for example, sulphonamides, have had much attention, and hormones—to borrow a Stock Exchange phrase—are a strong feature. The special needs of bombers and bombe and the general demands of industry have caused the problems of getting and successfully using the extra-light metals magnesium and aluminium to be continuously tackled.

IN the patent field, application activity often diminishes in quarters where the main problems have been solved and the stage of bulk production has been reached. For this reason, applications for patent protection for mercury arc rectifiers have fallen off, but television applications are more than maintained. The report itself should be read to get a comprehensive survey, but one of the most curious instances of the application of science to the peculiar needs of modern life should be noted; inventors have been busy with various forms of chance-apparatus for use by those who fill up football-pool coupons. Patents make strange bed fellows and air raids precautions succeed pool coupons in the report. The Comptroller has clearly had a busy time with legislation, as 1937 saw both a Patents and a Trade Marks Bill introduced into Parliament. Of these, the Trade Marks Bill has now gone through all its stages and received Royal assent.

Expenditure on Public Social Services

A RETURN showing the total expenditure under certain Acts of Parliament in the financial years 1900, 1910, 1920, 1930, 1935 and 1936 on public social services has recently been issued, covering expenditure from local rates, Parliamentary votes and other receipts, not being loans or receipts for capital purposes. The first part of the return shows that the total expenditure on these services in England and Wales has increased from £31·7 millions in 1900 and £54·95 millions in 1910 to £412·8 millions in 1930 and £440·5 millions in 1935. For 1936, the expenditure is estimated at 326 millions. The largest single item of expenditure is that under the Education Acts, which has increased from 16·9 millions in 1910 to 97 millions in 1935. Expenditure under the General Scheme of Unemployment Benefit in 1935 was 45·7 millions and Unemployment Allowances and Benefits 38·9 millions. Expenditure under the Old Age Pensions Acts has risen from 6·3 millions in 1910 to 39 millions in 1935, under the National Health Insurance Acts from 26 millions in 1920 to 34 millions in 1935. Under the Housing Acts expenditure has risen from 0·4 millions in 1900 to 42 millions in 1935, while under the Acts relating to the relief of the poor, expenditure has risen from 11·5 millions in 1900 to 44 millions in 1935. Public Health Acts now account for an expenditure of 16 millions as against a little over a million in 1900. Expenditure under the War Pensions Acts and Ministry of Pensions Act has decreased from 90·9 millions in 1920 to 36 millions in 1935. Expenditure in Scotland on the same services shows similar trends, the total having risen from £4·3 millions in 1900 to £50·3 millions in 1935. Particulars of the number of persons benefiting from this expenditure are included.

Training for Responsibility and Control

A REPORT on education, selection and training for positions of responsibility and control, by W. R. Dunlop, 57 Gordon Square, London, W.C.1, gives a summary of published views and methods in Great Britain with reference to executive and administrative positions in industry, commerce, agriculture, the civil services, the army, etc. Attention is directed to the confusion or disagreement as to management terminology in general, as to the main function of the educational system, the value of public school education and of social qualifications for positions of responsibility or control. On the other hand, the general agreement that, so far as management is concerned, the subject of a university degree does not greatly matter, which is emphasized by Mr. Dunlop, should be noted by scientific workers in supporting their claims for equal consideration for admission to administrative posts. Other matters on which there is general agreement are the necessity for avoiding excessive specialization in training; the importance of linking training for management with employment; the value of the "Case" method in specialized training; the unreliability of selection by interview or examination and especially the unsatisfactoriness of committee interviewing.

AMONG many specific recommendations of the report are the recognition of the value of the psychological view in education, selection and training and of the importance of moral principles in management. An adequate article in the "Encyclopædia Britannica" is advocated, and in regard to general education the significance of history and geography is stressed. Views on the transfer of subjects problem require further investigation, and more attention should be paid to the wider aspects of selection, such as systems or policies, as well as to the forecasting of vacancies. Managerial job analysis, attention to the claims of older and not exclusively the younger men, probationary periods, to the theoretical side of training schemes in industry and the development of an administrative section in the libraries of Government departments and business firms are also recommended. In addition to the list of findings and recommendations, the report includes a fairly

comprehensive bibliography the value of which unfortunately is considerably diminished by the incompleteness of the bibliographic detail.

The Service of Unified Knowledge

SOME time ago (November 18, 1936) we discussed, under the above heading, Mr. H. G. Wells's "Idea of a World Encyclopædia", a project designed "to hold men's minds together in something like a common interpretation of reality". Six months later (May 29), we published an article discussing Prof. Dobrowolski's scheme for paving the way for such a common interpretation by equipping every university with a "faculty of general knowledge". A full translation of its author's own account of the scheme appeared later in the *Sociological Review* (October 1937), including a description of the organization, subject-matter, time-tables and method of instruction of "Universitas Rediviva", a working model of the proposed faculty of general knowledge in operation in Warsaw. In the meantime, Mr. H. G. Wells has outlined in his address at Nottingham to Section L (Education) of the British Association, his ideas as to the informative content of the kind of liberal education that might be expected to produce minds capable of being held together by his world encyclopædia. The importance of such a "holding together of men's minds" has been clearly seen by the creators of the modern dictatorial regimes. In democracies it is equally important but much more difficult to achieve. Both Wells and Dobrowolski would probably subscribe to A. N. Whitehead's dictum: "There can be no successful democratic society till general education conveys a philosophic outlook" ("Adventures of Ideas". Cambridge: University Press, 1933).

Accessions to the British Museum (Bloomsbury)

AMONG accessions to the collections of the British Museum (Bloomsbury) reported at the June meeting of the Trustees is a remarkably fine spearhead found in the Thames at London, which has been on loan since 1931, and has now been presented to the Museum by the owner, Capt. John Ball. The spearhead, on account of its graceful shape, ranks with the famous Battersea shield and other examples of Celtic art in Britain of the period of high æsthetic qualities. It is of iron with two applied plates of bronze on each side, ornamented with Celtic scroll pattern. It dates from the beginning of the first century A.D. The most important accession to the Ethnographical Department consists of a generous selection of the antiquities from the Bay Islands off British Honduras, which were recently on exhibition in London (see NATURE, May 21, p. 932). These have been given by Lord Moyne, by whom the excavations were carried out. The remainder of the collection has been sent to Cambridge for study and distribution among various institutions. The examples of the Bay Islands culture allotted to the British Museum include a number of ocarinas or pottery whistles of various shapes, including a notable specimen in the form of a jaguar, while a remarkable product of the potter's art is a monkey swinging from a bough. The selection also includes a number of the small carvings in jadeite and soapstone and several of the stone hoes, while a large pottery beaker is especially interesting, as being comparable with one carved in white stone coming from the mainland of Honduras, which was already in the Museum. The Bay Islands culture is thought to date from between A.D. 1000 and 1500.

Recent Advances in Bird-Ringing

BIRD-RINGING in Britain, now organized from the bird room of the British Museum (Natural History), shows an increase not in the actual number of birds marked, but in the number of adult birds 'trapped' and thus marked and released, and a decrease in the number of nestlings marked; the mortality amongst nestlings is naturally high and thus the chances of recovery of ringed nestlings fewer. The statistics for 1937 show that 45,181 birds were ringed in Britain (*British Birds*, April 1938), as against 48,663 the previous year, bringing the grand total of birds marked in the country since the scheme was started in 1907 to 575,914. There was a record total of 'trapped' birds last year of 21,900 compared with 19,235 birds last year, and it includes a number of rarities not marked before, such as the waxwing and little bunting. Skokholm Bird Observatory, South Wales, for example, marked 4,402 birds in 1937, including the valuable total of 1,448 Manx shearwaters, 904 gannets and 603 razorbills. Mr. G. Charteris's list of 3,044 birds marked included 1,396 chaffinches, mostly at a winter roost; Mr. P. Morshead's total of 2,546 birds included 1,272 'trapped' starlings; Mr. A. Maynall's 2,024 birds including 348 nestling nightingales. The Zoological Society of London (through Mr. E. A. Billet) ringed a total of 1,144 birds at Whipsnade last year, these including 333 'trapped' jackdaws. Some of the leading boys' schools again take a prominent place in the ringing returns. Owing to the increased cost of the rings and the organization, there is an appeal for funds in addition to the general charges for the rings used.

Systems of Units

THE February issue of the *Journal of the Franklin Institute* contains a paper by Prof. W. M. Hall, of the Massachusetts Institute of Technology, on the formation of systems of units, which embodies portions of a 1936 copyright publication on the subject. The conditions for a self-consistent system of units are laid down and for translational kinematics length and time taken as fundamental. Translational kinetics then gives mass and rotational angle. Thermodynamics introduces temperature, light visibility and sound audibility. Electrodynamics admits of two possibilities: permittivity or permeability may be taken as fundamental and give the electrostatic or electromagnetic systems respectively. The questions of the sizes of the units to be chosen for convenience and of rationalizing or subrationalizing the units in which the coefficient 4π appears are discussed. Tables are given in which the units of the following systems are compared. The electro-

magnet with centimetre, gram, second and permeability of vacuum fundamental, the electrostatic with permittivity replacing permeability, and rationalized and subrationalized forms of each, the Gaussian mixed system with some quantities expressed in electromagnetic others in electrostatic units, the rationalized form of this, introduced by Heaviside and Lorentz, the Maxwell quadrant (10^9 cm.), 10^{-11} gram, second and permeability of vacuum, the Bennett and others, centimetre, 10^7 gram, and a unit of permittivity of vacuum $= 1/(8{\cdot}989 \times 10^{11})$, the Giorgi, metre, kilogram, second and 10^7 times the permeability of vacuum. The last three systems all have the ampere, volt and watt as units of current, potential and power respectively.

Trend of Design of Electric Locomotives

THE paper on the trend of the design of electric locomotives during the last ten years, read to the Institution of Electrical Engineers by C. E. Fairburn, the electrical engineer to the L.M.S. railway, is a valuable contribution to electric traction. He shows clearly that there is a growing demand for locomotives of greater power and speed. This is due partly to the necessity of improving running schedules with heavier trains and of avoiding the higher cost of multiple operation. Fairly complete data are given of ten electric railways in eight different countries and from twelve manufacturing companies. To analyse them is difficult because the outlook and methods vary not only from country to country but also from railway to railway in the same country. In Austria, Germany, Switzerland and Sweden low-frequency alternating current is employed; in Belgium, Italy and Poland, 3,000 volts direct current; France, Holland, Japan and much of the British Empire, use 1,500 volts direct current. Three-phase systems seem to be making little progress. In Germany, the express locomotive of the German State Railways is of 4,150 horse-power. Recent Swiss locomotives have 8,630 horse-power and the articulated express locomotives of the Pennsylvania Railroad can supply 9,500 horse-power for a short period. General experience with high-power locomotives, in particular on the Pennsylvania Railroad, shows that even larger horse-powers are desirable, especially on lines carrying heavy traffic. It is definitely stated that the advantages of electric braking on long gradients lie more in the reduction of wear in the mechanical parts than in the value of the energy returned to the supply system. With high speeds it is advisable to retain mechanical brakes for emergency operation as this makes higher speeds possible with safety.

Water Heating by Electricity

AT a meeting of the Association of Supervising Electrical Engineers held in London on April 12, P. Honey discussed the technical aspects of water heating by electricity. Since two trades were involved, namely, plumbing and wiring, the question of responsibility for satisfactory working has to be considered. The retailer of the appliance has to take upon himself the responsibility of planning the installation and, with the co-operation of a hot-water fitter, make certain that the workmanship is good. The problems of the water authorities are similar, in some respects, to those of supply undertakings. Unlike electric supply they have not the stimulus of competition. As water for domestic purposes is rarely charged for by quantity, the most urgent need is to prevent waste. They have therefore insisted that the fittings and appliances should be in accordance with certain specifications. To eliminate 'peak' demands which would cause serious drop in water pressure, the use of feed cisterns is insisted on by many authorities to ensure a more even demand. The amount of storage water held in this way in the houses of consumers is a considerable fraction of the total stored by the authorities. Regulations, therefore, were issued which restricted the connexion of electric water heaters of the thermal storage type direct to the cold water main. For example, in London, no heater larger than three gallons must be connected in such a manner. Those of larger size must be fed from an adequate storage system. No water authority in Great Britain would permit the connexion of a pressure water heater direct to the cold mains in the way frequently done abroad. The cost of servicing electric water heaters of all kinds is not a serious item. The majority of the few electrical defects which occur are probably due to the thermostat and are not serious.

Education in 1932-1934 in the United States

THE United States Office of Education has recently published its "Biennial Survey of Education 1932–1934" (Washington: Government Printing Office. Pp. 1222. Price 1.10 dollars). The effects of the economic depression, which touched its lowest point in 1932, are reflected in many of the statistical tables. The total aggregate income for education from kindergarten upwards in 1933–34 was about 2,604 million dollars, of which huge sum more than five sixths represent income of publicly controlled institutions. Compared with the corresponding figures for 1931–32, there was a decrease of 15·5 per cent, and compared with those for 1929–30 a decrease of 22·6 per cent. It is noteworthy that the decrease was twice as heavy in privately controlled as in publicly controlled institutions from 1932 to 1934, although it had been much lighter in the preceding biennium. Statistics of university enrolments which had risen continuously for many years showed a sharp drop after 1932. It is estimated that the percentage of boys and girls who on completion of their secondary school education entered a university or other institution for further education was in 1933 about 26. This is a high figure compared with the corresponding percentage in Great Britain, but it is low compared with the average percentage (44) of the years 1921–1929 in the United States.

University College, London

ITS recently issued annual report shows that this most cosmopolitan of all colleges in Great Britain numbered last year among its 3,284 students no fewer than 910 visitors from 52 countries outside the British Isles. By far the biggest contingent, 228,

came from India. From Germany came 73, Scandinavian countries 47, Switzerland 30, France 25, Holland 21; from Australia 30, New Zealand 27, Canada and Newfoundland 45, the United States 43, South Africa 37, Egypt 26, Palestine 28, China 35. For some years past the College reports have directed attention to the increase in the number of post-graduate and research students. Last year these advanced students numbered 616, and it is noteworthy that more than 40 per cent of them were from abroad, including 81 from India, 24 from Canada and Newfoundland, 23 from China, 22 from New Zealand, 18 from Australia, 18 from South Africa, 10 from the United States and 10 from Germany. A list of more than five hundred original papers and other publications from the various departments of the College in 1937 is appended to the report. A coloured plan shows graphically the growth of the College site and buildings since 1827.

Health of School Children

THE annual report for 1936 of the chief medical officer of the Board of Education, Sir Arthur MacNalty, entitled "The Health of the School Child" (London: H.M. Stationery Office. 2*s*. 2*d*., postage included) states that, during the year in question, the nutrition of more than 1,700,000 children was assessed with the result that 14·6 per cent were regarded as excellent, 74·2 as normal, 10·5 as slightly subnormal and 0·7 as bad; these figures are substantially the same as those in the report for the previous year. Free school meals provided have increased from 87,000,000 in 1935–36 to more than 100,000,000 in 1936–37. More than half the children who could receive milk either free or at half-price still fail to take it. Medical inspection and eyesight, care of the teeth, physical training and recreation and the national health campaign are some of the other subjects dealt with in this report.

Netherlands Indies

THE Colonial Institute of Amsterdam, which maintains a research department and an economic museum as well as an ethnographical department in conjunction with the Netherlands Pacific Institute, has published the first number of a new quarterly entitled *Bulletin of the Colonial Institute of Amsterdam* (18*s*. a year). The aim of the new publication is to give authoritative articles in English on various aspects of the Netherlands Indies. Only a small part of each number will be written in Dutch. Articles of scientific interest in the first number treat of malaria in the Netherlands Indies, social organizations of the peoples of Borneo, Celebes and the Moluccas, and air transport in the Pacific.

Asbestos

A RECENT publication of the Mineral Resources Department, Imperial Institute, is a monograph on asbestos by Mr. G. E. Howling (second edition. 2*s*.). The volume includes a discussion of occurrence, mining methods, uses, marketing and world production, and ends with a full bibliography.

Universal Esperanto Congress

THE thirtieth Universal Esperanto Congress will be held in London on July 30–August 6, under the high patronage of H.R.H. the Duke of Connaught. The total membership of the Congress is expected to be about 1,500, of whom some 1,300, representing twenty-five nationalities, had been enrolled at the beginning of June. The official proceedings will, as usual on these occasions, be carried on in the international language alone, no interpreters being employed either at the general meetings or at the sectional gatherings of specialists. Among the social features of the week will be two performances in Esperanto of "Eliza Comes to Stay" by members of the Neilson-Terry Guild of Dramatic Art, who have been learning the language for the purpose. It has been decided to hold next year's Congress at Bern, Switzerland.

The Night Sky in July

THE moon is full on July $12^d\ 15{\cdot}1^h$ and new on July $27^d\ 03{\cdot}9^h$ U.T. The only bright star to be occulted this month is λ Piscium, the reappearance of which will be visible from Greenwich on July 18 at $2^h\ 22{\cdot}4^m$, at position angle 198° from the north point of the moon's image. Lunar conjunctions with the planets occur as follows: with Jupiter on July $16^d\ 7^h$; with Saturn on July $20^d\ 0^h$; with Mercury on July $29^d\ 5^h$; and with Venus on July $30^d\ 9^h$. On July 26, Mercury is near Regulus, the minimum apparent separation (geocentric) being 0·9°; and on July $31^d\ 7^h$ Mercury is in conjunction with Neptune, the separation being 0·4°. Venus is a bright evening star, setting about $1^h\ 40^m$ after the sun in mid-July. Jupiter and Saturn are both visible during the night, Jupiter, a very bright object, southing about $2\frac{1}{2}^h$ in the middle of the month and Saturn three hours later. The interesting phenomena (eclipses, transits, occultations) of the Jovian four inner satellites may be followed with the help of the table and diagram given on p. 613 of the *Nautical Almanac* for 1938 or of the table on p. 170 of *Whitaker's Almanack*. At 22^h in mid-July, Vega is nearing the southern meridian and precedes the Milky Way. The bright star Deneb (α Cygni) on the galactic equator marks the apex of the bifurcation of the Milky Way, one branch passing southwards through Serpens and Scorpio; the other through Aquila, Scutum and Sagittarius. Interesting objects for telescopic examination abound in this region, which is also the habitat of the novæ. The 6th magnitude double-star, 61 Cygni, was the first star to have its distance successfully measured one hundred years ago by Bessel, who made his measures with a heliometer. His results gave the star's distance as 640,000 times that of the earth–sun distance; modern measures give 680,000 times this unit.

Announcements

THE RIGHT HON. NEVILLE CHAMBERLAIN has been elected a fellow of the Royal Society under Statute 12, which provides for the election of persons who "either have rendered conspicuous service in the cause of science, or are such that their election would be of signal benefit to the Society".

PROF. J. E. LITTLEWOOD, Rouse Ball professor of mathematics in the University of Cambridge, has been awarded the De Morgan Medal for 1938 of the London Mathematical Society. The Medal, which is awarded triennially, will be presented at the next meeting of the Society, on November 17.

THE following grants and scholarships from the Lady Tata Memorial Fund for research in blood diseases, with special reference to leukæmia, have been made for the academic year beginning on October 1, 1938: grants for research expenses or for scientific assistance: Dr. Julius Engelbreth-Holm (Copenhagen), Dr. M. P. J. Guérin (Paris), Prof. Dr. Karl Jármai (Budapest), Prof. James McIntosh (London), Prof. Eugene Opie and Dr. J. Furth (New York), Dr. Georg Weitzmann (Leipzig), Dr. Joachim Wienbeck (Breslau); whole-time scholarships: Dr. Jørgen Bichel (Aarhus, Denmark), Dr. Edoardo Storti (Pavia, Italy); part-time scholarship: Dr. Werner Jacobson (Cambridge).

MR. M. A. BAILEY has been appointed director of the National Institute of Agricultural Botany in succession to the late Mr. W. H. Parker, who died in January last. Mr. Bailey was educated at Dulwich College and Clare College, Cambridge, taking the Natural Science Tripos Part I (first-class honours) and the diploma of agriculture. After war service, during which he held the post of brigade major in the Royal Field Artillery, he was appointed botanist to the Egyptian Government. This was followed by service with the Empire Cotton Growing Corporation and his appointment as director of agricultural research to the Sudan Government, from which he has recently retired.

THE annual inspection of the National Physical Laboratory will be held on June 28.

THE new building for the Radcliffe Telescope at the University of London Observatory, Mill Hill Park, N.W.7, will be opened by the Astronomer Royal on July 1 at 4 p.m.

ON the occasion of the twenty-fifth anniversary of its foundation, the Swiss Röntgen Society has elected the following honorary members: Dr. C. Thurstan Holland of Liverpool, Profs. R. Kienbock of Vienna, Holthusen of Hamburg, Hans Meyer of Bremen, Perussia of Milan, De Quervain of Bern and Regaud of Paris.

PROF. WILHELM KREIS, of Dresden, has been awarded the Goethe Medal for Art and Science.

A NEW Institute of Medical Chemistry has recently been inaugurated by the Faculty of Medicine at Keio, Japan. The building alone will cost 100,000 yen. The new institute will serve not only as a research centre but also as a hospital.

DR. VICTOR E. LEVINE, professor of biological chemistry and nutrition at the Creighton University School of Medicine, has established a laboratory at Point Barrow equipped with all the latest apparatus for carrying on medical and biological research in the Arctic.

THE bronze Heberden Medal is to be awarded annually to a registered medical practitioner for the best work in the British Isles on the investigation of rheumatic diseases. The recipient will be invited to deliver the Heberden Lecture, which should contain a review of the work carried out for the award of the medal. The first award will be made in January 1939. Further information can be obtained from the Hon. Secretary, Dr. Kenneth Stone, 58 Chesterfield Gardens, W.1.

THE Institute of International Education announces that a Woolley scholarship in Paris is offered to a student in psychiatry for the year beginning October 1. The scholarship consists of 600 dollars and a room in the United States House of the Cité Universitaire in Paris, under whose auspices the offer is made. The candidate must be an American citizen. Applications should be made to the Institute of International Education, 2 West Forty-Fifth Street, New York.

A SUM of 66,000 dollars has been made available by the Rockefeller Foundation for the department of hospitals for the support of research on chronic diseases at the hospital now under construction at Welfare Island. The subjects for study include rheumatoid arthritis, the role of nutrition in chronic diseases, the role of cholesterol metabolism in arterio-sclerosis, circulatory and respiratory factors in pulmonary emphysema, bacteriological and immunological factors in acute and chronic glomerulonephritis, and various factors in hypertension.

THE Central Association for Mental Welfare has arranged a course for persons engaged in the training of mental defectives in occupation centres and institutions or mental hospitals and for home teachers to be held in London on July 4–23; also a course for officers of local authorities and local associations for mental welfare engaged in the ascertainment and supervision of defectives during the same period. Further particulars may be obtained from the Educational Secretary, Central Association for Mental Welfare, 24 Buckingham Palace Road, S.W.1.

COURSES on the "Physics of Metals", arranged especially for teachers, will be held in the University of Pittsburgh on July 5–August 12. Lectures will be delivered by Prof. N. F. Mott, Melville Wills professor of theoretical physics in the University of Bristol, who will be in residence for six weeks; Dr. John Bardeen, fellow of Harvard University, recently appointed assistant professor of physics in the University of Minnesota; Dr. Francis Bitter, associate professor of the physics of metals in the Massachusetts Institute of Technology; Dr. Foster C. Nix, research physicist at the Bell Telephone Laboratories; Dr. Frederick Seitz, research physicist at the General Electric Laboratories in Schenectady, New York. Colloquia on the physical tools of use in metallurgy, and on the creep, elastic properties, internal friction, mechanism of hardening and fatigue in metals are also being held.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 1145.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Kramers' Absorption Law in Astrophysical Problems

KRAMERS' well-known absorption law[1], long used by astrophysicists in their calculations of the opacity of stellar material, was first derived from classical mechanics and the correspondence principle, and may be stated thus:

$$\alpha_\nu = 0{\cdot}0104 \frac{Z^4 \lambda^3}{a_n n^3} g, \qquad (1)$$

where α_ν is the atomic coefficient of continuous absorption, Z is the effective atomic number, λ is the wave-length in cm., n is the quantum number, a_n is the statistical weight of the n^{th} state, and g is a factor very nearly unity.

Wave mechanical calculations have confirmed this result[2] for hydrogen, but have shown that it does not apply to hydrogen-like atoms[3], much less to other elements, as previously assumed. Laboratory measurements show that it is invalid for the alkalis[4] and not exact for X-ray absorption[5]. However, equation (1) has never actually been verified from observations on atomic hydrogen, which must be made at pressures sufficiently low for external conditions to have no effect[6].

It is not possible to measure the actual continuous absorption of light by hydrogen, but through Milne's fundamental relation[7] between photo-ionization and recombination, Cillié[8] has computed from equation (1) the relative numbers, p_n, of captures of electrons on the n^{th} level of a hydrogen atom in equilibrium with free electrons at an 'electron temperature', T_e. From an emission spectrum due to recombination we can determine the p's observationally from the following equations:

$$p_n = \sum_{r=n}^{\infty} K_{r,n} I_{r,2}, \text{ for } n > 2 \text{ (Carroll[9])}, \qquad (2)$$

p_2 = the number of quanta in the continuous emission at the head of the Balmer series. (3)

$I_{r,2}$ is the intensity of the $(r-2)^{th}$ Balmer line, and the K's are functions of the Einstein transition probabilities, which have recently been calculated up to $n = 14$ by Menzel and Pekeris[3].

Two published sources of Balmer emission intensities which might be used in equations (2) and (3) are measurements first in the solar chromosphere spectrum by Menzel and Cillié[10], and secondly in the spectra of several planetary nebulæ, measured at this Observatory[11]. Recently I have also measured intensities in the spectrum from the electrically undisturbed region of an electrodeless discharge in hydrogen. In the nebulæ and in the discharge it can be shown that the recombination of protons and electrons must account for almost the entire emission, and the electron temperatures have been measured (and found to be near 1000° K.). In the chromosphere, however, as Menzel and Cillié point out, the mechanism of line formation is uncertain. Furthermore, no use can be made of their results because (*a*) their "Balmer continuous emission" must include the intensity of unresolved lines (Menzel[12] lists more than 2·6 lines of intensity greater than "0" per angstrom in that region), and (*b*) there may be further errors due to the calibration and standardization.

In this investigation the carefully estimated observational errors are such that the values of p_n listed in the accompanying table must be accurate to about 15 per cent for the nebulæ and 5 per cent for the discharge. We are therefore justified in testing Kramers' law by comparing the observed p_n listed in columns 2, 3, and 4 with the theoretical values for $T_e = 1000°$ K. (If the transition probabilities $A_{m,n}$ used are in error, Kramers' law must similarly be so, since it was calculated by the same methods as the $A_{m,n}$.)

RELATIVE NUMBERS OF CAPTURES ON LEVELS OF THE H ATOM

	Observed p_n (1000° K.)			p_n from Kramers' law	
n	Discharge	Nebulæ		1000° K.	50,000° K.
2	0·012	0·675	0·039	21	37
3	17·9	—	40	13·5	17·6
4	10·0	10·0	10·0	10·0	10·0
5	5·53	5·9	5·0	7·5	6·2
6	2·62	3·7	2·0	6·2	4·2
7	1·19	—	—	4·9	2·9
8	0·725	(*NGC.* 7027)	(*NGC.* 7027)	4·0	2·2
9	0·366			3·4	1·6
10	0·202			3·0	1·3

Not only are the observed ratios $p_3 : p_4 : p_5$: etc. found to differ from those predicted in column 5, but also $p_3 \gg p_2$ (a peculiarity also observed for the alkali atoms[13]), whereas by Kramers' law $p_3 < p_2$.

We are thus forced to conclude that the use of Kramers' law in astrophysical problems is unjustified. A more detailed account of this investigation will shortly be communicated to the Royal Astronomical Society.

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June 7.

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Mechanism of the Primary Photodissociation Process of Organic Molecules

IN a recent letter to NATURE[1], Bergmann and Samuel advance a theory of photodecomposition of organic molecules according to which two bonds are fissured simultaneously, not by the splitting of two single bonds but by a transition to the repulsive state which corresponds to a reduction of valency of the central atom resulting from the re-formation of the s^2 group of this atom.

This conclusion is not new: it was shown in 1933 by Norrish, Crone and Saltmarsh[2] that the ketene molecule is decomposed photochemically according to the equation

$$CH_2{:}CO \rightarrow CH_2 + CO\ (^1\Sigma), \qquad (1)$$

and that the energy of the photolysing quantum (74 kgm. cal.) is insufficient to rupture the double bond (say, 167 kgm. cal.) unless the CO is liberated as normal carbon monoxide rather than as free carbonyl. Similar considerations were held to apply to the photolysis of diazomethane[3].

The idea was then tentatively extended to ketones[4,5]; for example,

$$CH_3COC_2H_5 \rightarrow CH_3 + C_2H_5 + CO\ (^1\Sigma), \qquad (2)$$

but it was emphasized that there was no evidence to show in these cases whether the two alkyl radicals are eliminated simultaneously or one rapidly after the other. Since then it has transpired that in the case of acetone the elimination takes place successively[6]; this was later confirmed more generally since in paraffinoid solution it was shown that the free radical RĊO formed can be hydrogenated to aldehyde[7] at temperatures exceeding 60°C.

The apparent result of equation (2) is thus due to the instability of the acyl group, which at 60° and upwards readily decomposes:

$$R\dot{C}O \rightarrow R + CO\ (^1\Sigma), \qquad (3)$$

presumably owing to the tendency of the carbonyl of the radical to revert to the repulsive singlet state.

These results have not been taken into consideration by Bergmann and Samuel, while the photolytic equations which they suggest are unsupported by evidence, and in some cases in disagreement with fact. All the evidence shows that ketones and aldehydes do not decompose by analogy with their equations. In the region of predissociation, formaldehyde yields molecular hydrogen and carbon monoxide in one act[8,9], while the αα dicarbonyl substance glyoxal decomposes according to the equation[10]

$$2HCO.CHO \rightarrow CO + CH_2OH.CO.CHO.$$

The decomposition of methyl glyoxal is analogous and diacetyl appears to be still more complicated, and none of the products can be derived from equations of the type suggested by Bergmann and Samuel.

It should be noted that so far as aldehydes and ketones are concerned, the heats of the reactions

$$RCOR \rightarrow R + R + CO\ (^1\Sigma),$$

$$RCOR \rightarrow R + R\dot{C}O,$$

though at present suffering from some uncertainty, are not very different, and that the threshold of continuous absorption is not sufficiently precise to be correlated with either, even supposing they were known accurately.

The mechanism of the photodissociation of SnI_4 and BiI_3 was first elucidated experimentally by Terenin[11]. Samuel and Parti[12] employ a modified mechanism to explain the long wave-length limit of the absorption spectrum of CI_4. The good agreement they obtain is dependent upon an uncertain assumption about the ratio of the heats of formation of $CHal_3$ and $CHal_4$ and also upon the use of a value 156·2 k.cal. for the heat of sublimation of carbon. Reliable sources[13,12] now consider the latter to be about 124 k.cal., a value which would completely upset their agreement. This has already been pointed out by Cherton[14], and the same remark applies to their other calculations.

Finally, it cannot be too strongly urged that with polyatomic molecules the principle of Franck, Sponer and Teller[15] comes into operation, and that the onset of predissociation is properly shown by the threshold of fluorescence rather than by the threshold of diffuseness[16]. With formaldehyde the former is at about 3700 A., and the latter at 2750 A., while the photochemical yield is unity on both sides of the limit of diffuseness, and the products unchanged[17]. Herzberg and Franz[18] set the true limit of predissociation at a wave-length longer than 3000 A. No evidence in support of Bergmann and Samuel is therefore forthcoming in the case of formaldehyde.

Generalizations of the type advocated by Bergmann and Samuel are unsafe because of the uncertainty of the precise values of the energy of many chemical bonds, and also because of the doubt as to the proper interpretation to be put upon diffuseness in the spectra of polyatomic molecules. They cannot be safely accepted in the absence of supporting chemical evidence.

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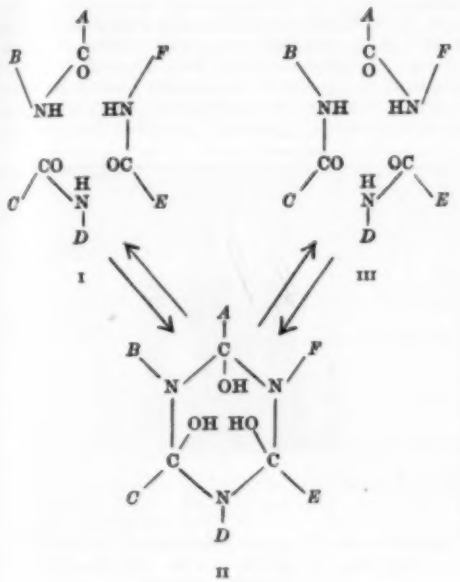
Possibility of the Formation of Cyclols from Simple Peptides

IN a series of communications in NATURE, Dr. D. M. Wrinch[1] has put forward a new hypothesis on the structure of certain proteins—the 'cyclol-theory'. According to this, peptide chains should be capable

of uniting to form two- and three-dimensional nets, three peptide residues forming a ring as in II:



I III

II

A, *C*, and *E* represent residues of the type R.CO.NH.CHR-; *B*, *D*, and *F* residues of the type R.NH.CHR.CO-.

Compounds of this kind (II) are unknown, and a consideration of the thermal data shows that it is improbable that they should occur in considerable quantity in equilibrium with free peptides. It seemed to us of interest to ascertain whether they occur even in minute quantities in tautomeric equilibrium with free peptides, and whether their presence could be demonstrated indirectly.

In the cyclol compound II, the residue *A* is united to both *B* and *F* in the same way. This compound may be formed by condensation of peptide *AB* with *CD* and *EF* (I → II), but also from the peptides *AF*, *ED*, and *CB* (III → II). In the reconversion of a cyclol to its peptides, therefore, not only should the original material be obtained but also a mixture of peptides: in this case, from those in I, those in III as well. In other words, the peptides must be able to exchange residues with one another if cyclols are formed (even in minimal quantity) in tautomeric equilibrium.

Glycyl *l*-leucine and *l*-leucyl glycine were mixed; these should have interchanged to form partially *l*-leucyl *l*-leucine and glycyl glycine if cyclol formation takes place at all. Observation of the optical activity showed, however, that no such reaction can be detected, either in neutral aqueous solution or in solutions of the chlorhydrates or of alkali salts. The rotation of equimolecular mixtures of both peptides was equal to the mean of the rotations of the two peptides (see accompanying table) and remained so for twenty-four hours. Any formation of *l*-leucyl *l*-leucine would have led to a considerable diminution in the rotation.

		neutral	acid	alkaline
$[\alpha]_D^{20}$	*l*-leucyl glycine	+77·6	+44·3	+25·0
"	glycyl *l*-leucine	−35·3	−34·1	−19·7
	mixture (observed) ..	+21·7	+5·2	+2·8
half rotation of *l*-leucyl *l*-leucine		+3·5	—	−6·7

Cyclol formation does not, therefore, occur under these conditions. This does not speak favourably for the 'cyclol-hypothesis'. It seems highly improbable that the nature of the peptide linkage may be so modified by lateral substituents, that a reaction which is entirely absent from simple peptides becomes possible in proteins.

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May 11.

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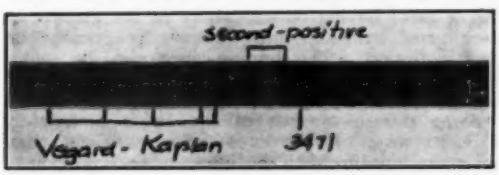
A New Nitrogen Line

RECENTLY[1], I reported the preliminary study of a nitrogen afterglow at high pressures, rich in the Vegard-Kaplan bands and containing a line at 3471 A. which was tentatively identified as the hitherto unobserved transition $^2P \rightarrow {}^4S$ in atomic nitrogen. That report was based on observations of the afterglow from two tubes, in one of which the nitrogen was purer and at a lower pressure than in the other. Further observations on these tubes has enabled us to study the variations in intensity of the Vegard-Kaplan bands and the new line, both with respect to pressure and to purity.

There is definite indication that the 3471 line increases in intensity as the tube approaches the pure nitrogen stage, and that its rise in intensity in one tube follows that of the intercombination bands, and that its fall with pressure in the other tube also follows these bands. The spectrum reproduced herewith shows the line-like character of this radiation, its extraordinary intensity relative to the normally strong second-positive bands, and the large intensity of the Vegard-Kaplan bands. There is also indication



HIGH-PRESSURE NITROGEN AFTERGLOW PHOTOGRAPHED ON A SMALL QUARTZ SPECTROGRAPH. STRONG BANDS TO RIGHT OF λ 3471 ARE DUE TO CYANOGEN; OTHER WEAK BANDS DUE TO NO.

in these experiments of the increase with pressure of both the Vegard-Kaplan bands and the 3471 line. The enhancement of these relatively forbidden transitions with pressure is indeed a strange phenomenon, when one remembers that similar transitions in neutral oxygen and in various stages of ionization of oxygen and nitrogen are responsible for some of the strongest lines in the spectra of nebulæ. These nebular lines are strengthened at low pressures. In fact, it is generally agreed that low pressures are necessary for such forbidden transitions, and the present experiments are probably the first evidence to the contrary.

The absence of any of the forbidden transitions of non-ionized atomic nitrogen in the spectra of celestial

objects appears to find its explanation in these experiments. More interesting for the physics of the upper atmosphere is the conclusion from these results that the Vegard-Kaplan bands, the 3471 line, and possibly other radiations in the light of the night sky, are emitted in the lower rather than in the higher regions of the upper atmosphere, perhaps so low as 50 km. This conclusion is based on the presence in the light of the night sky of a strong line at 3471 and of the Vegard-Kaplan bands. In fact, the spectrum reproduced here is an excellent reproduction of the light of the night sky.

The tube from which this plate was photographed is now rapidly approaching a pure nitrogen stage. The next two or three photographs should give us valuable information regarding the relationship between this line and the Vegard-Kaplan bands, as well as further proof that the line is characteristic of pure nitrogen.

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[1] Kaplan, NATURE, 141, 645 (1938).

Possible Presence of Metastable Atoms of Nitrogen (^2P) in the High Atmosphere

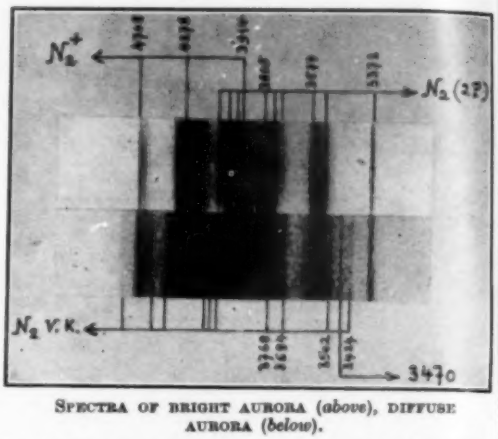
DURING a stay at the Tromsø Observatory, I studied systematically the spectrum of different forms of auroras (arcs, draperies, clouds, corona, etc.). One hundred spectrograms were thus obtained in the autumn of 1937. The analysis of these data is now being carried out, but some important facts are already apparent.

The spectrum of the bright region of an intense aurora (arc, draperies, corona) always offers the same general aspect. Outside the red and green lines of O I, the bands of the three systems of nitrogen, N_2^+, $N_2(1P)$ and $N_2(2P)$ only are observed (see upper spectrum, photographed on a Guilleminot Superfulgur plate having no sensitivity in the green). A very great over-exposure discloses practically no new radiation. The luminescence can be reproduced by submitting nitrogen to an electronic bombardment with a proper accelerating potential[1].

Some diffuse auroras behave in a completely different way. If the exposure is sufficient, their spectrum contains, with the lines and bands previously mentioned, a relatively great number of other radiations, generally weak and difficult to identify. However, these radiations may show so large an increase in intensity that their study becomes easy. It may be ascertained that they are the nitrogen bands $A \rightarrow X$, known as Vegard-Kaplan bands. The heads located at 3424, 3502, 3684, 3768, 4045, 4073, 4171, 4425 and 4535 A. are particularly distinct; these bands are plainly degraded toward the longer wavelengths (see lower spectrum).

With the Vegard-Kaplan bands, and evolving in the same way, an intense and sharp line always appears near 3470 A. (3470·3 A., according to the best measurements). Its appearance is such that it is easily distinguished from the neighbouring bands, and that any trial of identification with the 3469 $N_2(2P)$ band is impossible. As no other plausible interpretation comes to the mind, it seems reasonable to admit the presence of the atomic nitrogen line $^2P \rightarrow {}^4S$, the computed position of which is also 3470 A. This attribution is in perfect agreement with the recent observation by Prof. Kaplan[2] of a high-pressure afterglow in nitrogen, giving near 3470 A. a strong line associated with the Vegard-Kaplan bands.

As Prof. Kaplan suggests, the radiation reported at 3471 A. in the night sky light (Dufay, Gauzit) is perhaps also the nitrogen line $^2P \rightarrow {}^4S$. But the spectrum of the sky is so complex that it is difficult to give weight to this attribution. On the contrary, the simultaneous presence of the 3470 line and of the



SPECTRA OF BRIGHT AURORA (*above*), DIFFUSE AURORA (*below*).

Vegard-Kaplan bands in the aurora and in the afterglow, with a similar evolution, seems to prove that the radiations emitted in both cases have the same origin. The fact is obvious for the Vegard-Kaplan bands; it is highly probable for the 3470 line. If we consider that active nitrogen is doubtless a mixture of metastable nitrogen molecules and atoms, the attribution of the 3470 line to the transition $^2P \rightarrow {}^4S$ becomes quite normal.

The presence of nitrogen atoms (^2P) in the auroral region must then be taken into consideration, and we may expect to find also the lines corresponding to the transitions $^2P \rightarrow {}^2D$ ($\lambda = 10{,}400$ A.) and $^2D \rightarrow {}^4S$ ($\lambda = 5206$ A.). The first one occurs in a part of the spectrum which has not yet been explored. The other, which is much less probable, was not recognized in the aurora or the light of the night sky. A more complete and thorough analysis of the two spectra and, above all, the study of the 3470 line by the interference method, should give the definitive solution of the problem.

The actual state of our knowledge, however, permits us to conclude that, in the aurora, the mechanism of excitation includes probably the two following stages:

(1) An electronic bombardment, which is the primary phenomenon and produces the permanent radiations of the spectrum.

(2) An afterglow, similar to that of Kaplan, giving rise to the nitrogen bands $A \rightarrow X$ and to the 3470 (NI, $^2P \rightarrow {}^4S$) radiation. This second process seems very important in certain diffuse auroras.

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[2] Kaplan, J., NATURE, 141, 645 (1938).

Quantitative Measurement of Vitamin B_1 by the Thiochrome Reaction

In 1936, Jansen[1] first suggested that vitamin B_1 could be measured quantitatively by conversion into thiochrome with alkaline ferricyanide and measurement of the fluorescence of the thiochrome. Since that time, information has been collected on the use of this method for the assay of vitamin B_1 in urine[2,3,4] and in other materials including foodstuffs[5]. Evidence, however, is now accumulating that, although results which compare closely with the biological assay can be obtained with crystalline vitamin B_1 and acid-clay adsorbates of the vitamin when the precautions described elsewhere[5] are exercised, the assessment by the chemical method on certain foodstuffs is significantly lower than the biological results.

Biological assay (Int. units per gm.)	Chemical assay (Int. units per gm.)	Chemical/Biological
9·5 10·0 10·0 10·0 10·5 Avg. = 10·0	6·8 6·3 7·9 8·1 7·6 Avg. = 7·3	73 per cent
11·0 11·0 11·0 11·2 11·2 11·2 11·5 11·5 11·5 Avg. = 11·2	6·8 7·2 8·1 6·7 6·9 8·6 6·2 6·4 6·4 Avg. = 7·0	62 ,,
12·0 12·0 12·0 12·5 12·5 12·5 12·5 12·5 Avg. = 12·3	5·1 6·5 7·6 6·7 7·2 7·3 7·5 8·6 Avg. = 7·1	58 ,,
14·0 15·0 15·0 16·0 16·2 20·0 Avg. = 16·0	6·8 6·7 6·2 6·6 5·9 8·1 Avg. = 6·7	42 ,,

The accompanying table gives the comparative figures for vitamin B_1 in twenty-eight samples of wheat embryo. The biological assays were carried out by Dr. A. Z. Baker of this laboratory by the bradycardia method[6]. A minimum of six rats was used in each case.

Other foodstuffs appear to give similar results. Certain proprietary yeast preparations, for example, contain substances with a considerable blue fluorescence, and frequently no additional intensity of fluorescence develops after ferricyanide oxidation. The chemical assay therefore appears to be zero, although the usual activity of 6–10 international units per gram of vitamin B_1 is known to be present.

Vitamin B_1-pyrophosphate, which appears to be of fundamental biological significance, is insoluble in isobutyl alcohol[7] and is not therefore included in the chemical assay. It has also recently been suggested[8] that vitamin B_1 exists combined with protein, in which form it might be expected to be difficult to extract chemically from tissues. Therefore the quantitative recovery of crystalline vitamin B_1 added to a substance under analysis cannot be taken as evidence that the results obtained for that substance by the thiochrome method are a complete measure of the vitamin activity of the material.

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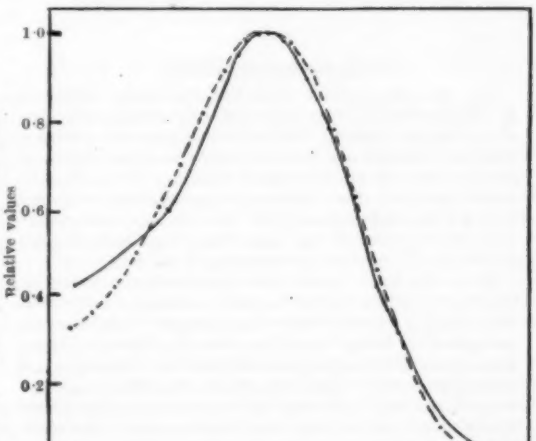
Scotopic Luminosity Curve and the Absorption Spectrum of Visual Purple

MANY attempts have been made to explain the discrepancy between the scotopic luminosity curve and the absorption spectrum of visual purple. Recently, Dartnall and Goodeve[1] have applied the Stark-Einstein law in order to express the luminosity curve in terms of quanta and have shown that the resulting correction was insufficient.

A consideration of various additional possible factors, such as Kundt's rule and the retinal grey, which might explain the discrepancy, convinced me that the scotopic luminosity curve should be corrected for the absorption spectrum of the ocular media. It is known that this spectrum varies considerably with the genus of animal, and for man has not hitherto been determined through the visible spectrum. Recently, however, in collaboration with E. F. McCarthy, I completed measurements of the absorption spectrum in the wave-length range 400–820 mμ for the refractive media of the human eye. Preliminary reports[2] of this work have already been made and a paper giving the results will appear shortly[3].



– – – – ABSORPTION SPECTRUM OF VISUAL PURPLE OF THE FROG (LYTHGOE).
——— SCOTOPIC RETINAL LUMINOSITY CURVE (LUDVIGH AND MCCARTHY).

It will suffice here to give the results obtained by applying the Stark-Einstein law and data on the young normal human eye to transform a scotopic *ocular* luminosity curve into a very different curve, namely, a scotopic *retinal* luminosity curve. This permits the comparison of the absorption spectrum of rhodopsin with the *retinal* luminosity curve instead of with the *ocular* luminosity curve.

The accompanying graph shows the agreement of the transformed data of Hecht and Williams[4] with Lythgoe's data[5] on the absorption spectrum of visual purple. The conclusions drawn from this curve are: (1) The retinal sensitivity for blue is much greater than has been previously assumed. (2) It is not necessary to invoke Kundt's rule, as did Hecht and Williams[4], to explain the discrepancy between the

two sets of data. (3) It is not necessary to assume that, because of their relatively high absorption coefficients in the blue, solutions of visual purple recently prepared[5,6,7] are different from those of the solutions of visual purple present, under low illuminations, in the intact retina *in situ*.

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Cosmological Theory

ON the assumption that the red-shifts observed in the spectra of the extra-galactic nebulæ are due to a Doppler effect, Hubble's observations indicate that the nebulæ are receding from us with velocities proportional to their distance from us. Thus at each point in space there exists a characteristic velocity and a preferred time-axis in four-dimensional space-time, this preferred time-axis being that with respect to which the matter at the point is at rest.

This absolute time and characteristic velocity, which varies from point to point in space, has formed the starting point of two cosmological theories, one proposed by Milne[1] and the other by Dirac[2]. Milne introduces the assumption called the 'cosmological principle', which asserts that the universe is everywhere uniform and has spherical symmetry about every point for an observer moving with the characteristic velocity at that point. Milne's theory further requires that all constants appearing in the theory are to be dimensionless.

Dirac, while accepting the cosmological principle, rejects the 'dimensional hypothesis' of Milne and proposes in its place the assumption that "any two of the very large dimensionless numbers, of the order of 10^{39} and 10^{78}, which appear in Nature are connected by a simple mathematical relation in which the coefficients are of the order of magnitude unity".

The theories of both Milne and Dirac lead to the conclusion that there are two time-scales of importance, one for atomic phenomena and the other for ordinary mechanical phenomena. If we denote the measure of a small interval of time on the first of these scales by dt and the measure of the same interval of time on the other scale by $d\tau$, then Milne's theory requires that

$$dt = (t/t_0)d\tau, \qquad (1)$$

where t is the epoch at which the two measures are made and t_0 is the present epoch, that is, the present age of the universe. In place of (1), Dirac's theory requires the relation

$$d\tau = t dt, \qquad (2)$$

where, in both (1) and (2), the t-scale of time is the natural scale for atomic phenomena and the τ-scale is that for macroscopic phenomena to which general relativity applies.

On Milne's theory, an atomic clock keeps t-time while a planetary clock keeps τ-time, and the laws of Nature and the equations of motion have their usual form when expressed in τ-time. Since a velocity has the same measure on both *time-scales, the t-measure and the τ-measure of a distance have different values*.

A little more than a year ago, I investigated the consequences of the assumption that *the measure of a distance is the same on both time-scales*, and hence a velocity measured in t-time differs from the value obtained when a τ-clock is used. The laws of mechanics, the equations of motion and general relativity are all assumed (as results from Milne's theory) to hold in τ-mechanics. In fact this requisite *defines* τ-time. The first consequence of this theory is that the proper energy of an elementary particle mc^2, which is constant in τ-mechanics, varies inversely as the square of the epoch in t-mechanics. If we now *define* the number of elementary particles in the universe as the total energy of the universe divided by the element of energy mc^2, and assume that the total energy of the universe is conserved, we have the result that the number of particles in the universe varies as the square of the epoch, a suggestion which was originally put forward by Dirac[3].

Without the introduction of any further assumptions and without any appeal to general relativity, the results below follow.

$$GM = kc^3t,$$

where G is the gravitational constant, M the mass of the universe, c the velocity of light and k a dimensionless constant which is taken as unity. This shows that the gravitational constant depends upon the total amount of matter in the universe—a conjecture which has often been made in the past. The total number of particles in the universe is given by

$$N = \tfrac{1}{2}t^2,$$

where t is to be expressed in atomic units e^2/mc^3. The present age of the universe is found below to be 2×10^9 years. This gives the value $2{\cdot}31 \times 10^{79}$ for N, which is of the same order as the value obtained by Eddington[4].

The radius of the spherical model of the universe is found to be $R = ct$, which is *constant* in both t-mechanics and τ-mechanics. The value is $1{\cdot}89 \times 10^{27}$ cm., which is of the same order as the radius of the Einstein universe, namely, $1{\cdot}23 \times 10^{27}$ cm. On this theory the red-shift in the spectra of the extra-galactic nebulæ is due, not to a Doppler effect, but to a decrease in the velocity of light in t-time. The formula obtained for the red-shift is

$$\frac{d\lambda}{\lambda} = \varepsilon^{d/t_0} - 1,$$

where d is the distance of the nebula in light-years and t_0 is the present age of the universe. When d is small compared with t_0, this reduces to the usual linear relationship $d\lambda/\lambda = d/t_0$. Hubble's empirical formula is $d\lambda/\lambda = 5{\cdot}71 \times 10^{-18}d$, and thus $t_0 \sim 2 \times 10^9$ years.

The theory also gives the equation

$$m = \frac{\sqrt{2}}{137}\,\frac{h}{2\pi c}\,\frac{\sqrt{N}}{R}$$

for the relation between the mass m of an electron and the number of particles in the universe at the present epoch. This should be compared with Eddington's equation[4]

$$m_0 = \frac{h}{2\pi c}\,\frac{\sqrt{\frac{1}{2}N}}{R},$$

where m_0 is the mass of a neutral particle of the comparison fluid. From Eddington's theory, $m_0 \sim 136\,m$.

Finally, the theory leads to the uncertainty relation in the form

$$\triangle p\,\triangle q \sim \frac{h}{4\pi},$$

and thus links quantum theory with cosmological theory.

It thus appears that a reasonable and self-consistent theory of cosmology can be built up from the initial assumption that a planetary or pendulum clock measures time at a different rate than does an atomic clock, the relationship between the two measures of a small interval of time being given by (1). The theory is based essentially upon this single assumption, together with the principle of the conservation of energy. An observer, measuring time by an atomic clock, concludes that, although the total energy of the universe remains constant, the number of elementary particles as defined above is increasing as the square of the epoch, and that there exists a definite epoch of creation. An observer, measuring time by a rotating planet, finds the usual laws of mechanics and the Newtonian and relativistic equations of motion to hold good. He concludes that the number of particles in the universe is constant, and that the universe has existed, though not necessarily in its present configuration, for an infinite time.

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[2] Dirac, *Proc. Roy. Soc.*, A, **165**, 199 (1938).
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Thermal Expansion and 'Co-operative Phenomena'

A RECENT investigation[1] on the dielectric polarization of a ketone near the melting point shows a considerable difference between the temperature — polarization curves at constant volume and at constant pressure. The change of volume thus appears to have a considerable effect on the free rotation of molecules in the lattice, which is a 'co-operative phenomenon'.

It seems not unlikely that volume changes might be of importance in other 'co-operative phenomena'. The order-disorder transition of β-brass is experimentally investigated at constant pressure. The existing theories take no account of the experimentally observed change of volume. Actually, the theoretical maximum of specific heat is too small, and the slope of the temperature—specific heat curve at temperatures below the maximum is about 1/15 of the experimental value, which discrepancy may be due to the neglected expansion.

In order to test this view, I carried out a calculation of the specific heat at constant pressure. The energy of a zinc-copper pair is assumed to be proportional to the square of volume change. A similar assumption is made for the mean energy of copper-copper and zinc-zinc pairs, their minimum energy lying at higher volumes than the minimum of copper-zinc. In each of these parabolic energy curves a parameter is introduced. The method of calculation is similar to the theory of Bragg and Williams.

The specific heat—temperature curve obtained can be adjusted so as to give good agreement with experiment. It appears to be not very sensitive relative to variations of one parameter. The assumed dependence of copper-zinc energy on volume is compatible with the energy as calculated from the compressibility of brass and the observed expansion. By this calculation, the details of which are to be published shortly, it is shown that even a small expansion may have considerable effect on the specific heat.

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[1] Müller, A., *Proc. Roy. Soc.*, A, **166** (1938).

Occurrence of *Zelleriella*, an Opalinid Ciliate, in South Africa

THE fauna and flora of the southern extremity of Africa present a number of striking resemblances to those of South America on one hand and Australia on the other. I have recently come across an unexpected addition to this number in finding *Zelleriella* in the recta of two different species of *Rana* from the neighbourhood of Cape Town. According to Bigalke[1] there appear to be no records of the establishment of any exotic amphibia anywhere in the Union of South Africa and we must therefore assume that the Cape Zelleriellas are indigenous. The following zoogeographical data suggest their significance.

(1) *Zelleriella* is the dominant Opalinid of tropical America, its principal hosts being the toothed bufonids (Cystignathidæ or "Leptodactylids"). Elsewhere, except for one questionable record from a toad from "Asia", they have only been found in Australia, where their hosts are exclusively leptodactylids.

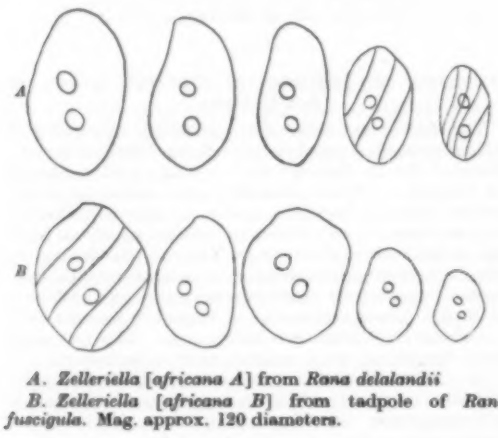
(2) The toothed bufonids also occur at the present day only in Central and South America and in Australia.

(3) From these facts Metcalf[2] concludes that the leptodactylids originated in Argentina–Patagonia and crossed to Australasia by an early Miocene land-bridge. *Zelleriella* was originally a parasite of these toads and migrated with them, but infected other amphibia as it spread northwards in America. The recent discovery in India of a Miocene Cystignathid closely resembling the present-day Australian genera, however, weakens this argument[3].

(4) The Cape Zelleriellas apparently do not extend far towards the north, for none were found by Fantham[4] in his extensive investigation of the parasites of amphibia in the Transvaal. In view of their ability to live in a variety of amphibian hosts, it is difficult to believe that these ciliates can have come from the north without leaving representatives in other parts of Africa. Their presence in the Cape consequently is most easily explicable on the hypothesis of former land connexions with the other southern continents, in which case their history must

extend back to late Secondary times. As no toothed bufonids occur in Africa, the question of their original hosts in this continent is a puzzle on any hypothesis.

(5) The distribution of the other genera of Opalinids also fits in with this idea. *Protoopalina* is by far the commonest member of the family throughout Africa, and it is noteworthy that the species regarded by Metcalf as archaic are those found in Patagonia, Papua, Australia and Africa. *Opalina* and *Cepedea*, though otherwise practically cosmopolitan, have not been recorded from either Australia or the Cape. Both occur in Central Africa, and Fantham[4] (1923, 1924, 1927, 1931) found *Opalina sudafricana* very occasionally in *Bufo regularis* at Johannesburg. (Incidentally, if Metcalf's view is correct that the *Opalinæ angustæ*, to which this species obviously belongs, form a natural subdivision of the genus, this record is a curious one. The *Opalinæ angustæ* are characteristic of the tree-frogs of North America, only one species, *O. obtrigona*, having crossed over to Europe and Asia, to which it was carried by its host, *Hyla arborea*.) In Africa, it seems, all these ciliates spread much less freely than their hosts.



A. Zelleriella [*africana A*] from *Rana delalandii*
B. Zelleriella [*africana B*] from tadpole of *Rana fuscigula*. Mag. approx. 120 diameters.

(6) The Ranidæ are an Old World group showing their greatest diversity of type in Africa. Only one species has penetrated to North America, and this has been found infected with *Zelleriella* in California, the northernmost limit of the parasite.

(7) The common frog for class purposes here is *Xenopus*, a member of the Pipidæ (Aglossa). This family is at present found only in South America and Africa. It is, however, regarded as of northern origin, and no Zelleriellas have been found in any member of it.

In the present state of our knowledge, it is impossible to subdivide the Zelleriellas into species, and we cannot therefore say whether the Cape forms are more nearly akin to those of Australia or of America. They have been found once in *Rana delalandii* and once, from a different locality, in a tadpole of *Rana fuscigula* (I am indebted to Dr. W. Rose for the identification of the frogs). The two forms differ somewhat and may be referred to as *Z.* [*africana A*] and *Z.* [*africana B*] respectively, the brackets being used, as by Metcalf, to indicate that the names are for reference only and do not necessarily imply specific status. In neither is there any clear demarcation of ectosarc from endosarc, and the chief differences are that form *B* is broader and less regular in outline than form *A* and that the cytoplasm of *A* is vacuolated whereas that of *B* is granular.

The principal measurements of adult specimens are:

	Form *A*	Form *B*
Greatest length	124μ – 213μ	92·5μ – 167μ
Ratio: length/breadth ..	1·72 – 2·07	1·28 – 1·65
Nuclei	12·5 × 15·6μ – 20·3 × 23·1μ	9·6 × 10·6μ – 19·7 × 22·2μ
Distance between rows of cilia	1·3 – 2·0μ	1·85 – 2·6μ

Typical outlines are shown in the accompanying figures, the direction of the rows of cilia being indicated in a few cases.

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May 4.

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[4] Fantham, H. B., *S. Afr. J. Sci.*, *passim* (1918–32).

Irregular Mitosis and Meiosis induced by Acenaphthene

PARTICLES sublimed from the crystals of the biologically active substance which, according to Shmuck, induced morphological peculiarities similar to those induced by colchicine, were used for altering the normal procedure of the mitotic and meiotic processes.

Germinating seeds from cereals and grasses (wheat, rye, oat, barley, maize, rice. *Festuca*, *Lolium*, etc.), covered by crystals of acenaphthene for 4–8 days, grow slowly, forming very thick and short roots and leaves. Leguminous plants (*Vicia*, *Ervum*, *Lathyrus*, *Medicago*, etc.) reacted after a longer exposure (6–12 days). Species of Compositæ tested occupied a position between these two groups of plants.

Mitosis in treated seedlings proceeds abnormally. The activity of the factors responsible for the arrangement of the chromosomes in a regular equatorial plate and for the formation of the achromatic figures (spindles) is inhibited. The chromosomes do not become arranged in a regular equatorial plate. They divide but do not move toward the poles, thus forming polyploid nuclei. Sometimes the chromosomes become abnormally spread into the cytoplasm, giving rise to polynucleate cells. The latter might lead to heteroploidy.

Branches with floral buds of nine *Nicotiana* species were treated with acenaphthene particles. In buds in which meiosis proceeded, abnormal processes were induced. One usually finds during the meiotic metaphase the expected number of bivalent chromosomes, but they do not become arranged on a regular equatorial plate; they occupy positions similar to those of diakinesis. The chromosomes divide without being 'pulled' to the poles. They spread abnormally into the cytoplasm in groups of several chromosomes or even as single chromosomes. This conditions the formation of variable numbers of nuclei at the end of the second division. Each nucleus or group of nuclei is separated during cytokinesis, thus forming a variable number of microspores with one or more than one nucleus. Consequently the microspores have unequal chromosome numbers. This gives rise

to a large percentage (50–100 per cent) of abortive pollen. The viable pollen grains are equal in size, containing unequal chromosome numbers. They can give rise to plants with aberrant chromosome numbers.

DONTCHO KOSTOFF.

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Academy of Sciences,
Moscow.

Decomposition Reactions of Organic Compounds in the Gaseous State

PERHAPS Prof. Hinshelwood will excuse me if I suggest that no useful purpose is effected by discussing the treatment of isolated sets of experimental data on the lines indicated in his letter in NATURE of June 4, p. 1010. Space would not permit me to go into the question in detail; and to counter with similar illustrations from his own work would be waste of time. Doubtless our methods are very far from perfect, and I may say that after, not merely twelve, but forty-two years' experience of work with gases, I find that the difficulties are such that the greater part of the work of most labourers in this fascinating field washes out.

That we hold differences of opinion as to the way in which problems in kinetics of gas reactions should be handled is well known. I do not suppose that anyone who is not interested in the subject reads my papers, or those of Prof. Hinshelwood; but it is scarcely reasonable to imagine that anyone criticize his work on the basis of hearsay information regarding mine. If anyone does so, or *vice versa*, does it matter?

M. W. TRAVERS.

Department of Chemistry,
University, Bristol.
June 9.

Points from Foregoing Letters

FROM his measurements of intensities in the Balmer emission spectrum due to recombining protons and electrons in the gaseous nebulæ and in an electrodeless discharge tube, T. L. Page concludes that Kramers' absorption law is invalid for hydrogen. The use of this law in astrophysical problems is therefore unjustified.

Prof. R. G. W. Norrish enumerates several objections to the theory put forward by Bergmann and Samuel to account for the photo-decomposition of organic molecules by the simultaneous fissure of two bonds, that is, by a reduction of valency of the central atom.

Prof. K. H. Meyer and W. Hohenemser find that the two peptides glycyl *l*-leucine and *l*-leucyl glycine do not interchange their constituent groups in solution. From this they infer that, under the conditions of the experiment, no molecules of the cyclol type are formed.

Further studies of the high-pressure nitrogen afterglow leads Prof. J. Kaplan to the view that the new 3471 line is closely related in its intensity variations with the Vegard-Kaplan bands. The spectrum reproduced is a good laboratory reproduction of the night sky spectrum and suggests the hypothesis that the light of the night sky originates low in the upper atmosphere.

Photographs of spectra of bright and diffuse auroras are submitted by R. Bernard. The spectrum of the diffuse aurora shows an intense sharp line at 3470 A. This may be ascribed to atomic nitrogen ($^3P \rightarrow {}^4S$), and the author concludes that the mechanism of excitation in the aurora probably includes two stages: an electronic bombardment producing the permanent radiations of the spectrum; and an afterglow giving rise to the nitrogen bands.

The chemical assay of vitamin B_1 gives lower values than the biological assay, according to results obtained by Dr. M. Pyke. The author ascribes this to incomplete extraction.

Using data of Hecht and Williams on the absorption of visual purple, and taking into consideration the absorption spectrum of the ocular media, Ludvigh and McCarthy have obtained the retinal luminosity curve for scotopic (twilight) vision. Comparison of this curve with that for the absorption spectrum of visual purple of the frog (Lythgoe) leads E. Ludvigh to revise some of the previously accepted views and to conclude that the retinal sensitivity for blue is much greater than has been previously assumed.

From the initial assumption that a planetary or pendulum clock measures time at a different rate than does an atomic clock (as explained by Milne), also accepting the principle of the conservation of energy and assuming that the measure of a distance is the same on both time-scales, Dr. F. L. Arnot deduces that for an observer measuring time by an atomic clock the number of particles in the universe varies as the square of the age of the universe (2×10^9 years). On the other hand, using the pendulum time scale, the number of particles in the universe appears constant, but the age of the universe becomes infinite.

Dr. R. Eisenschitz announces that he has calculated the specific heat of brass at constant pressure, and that the 'specific heat - temperature' curve obtained can be adjusted so as to give good agreement with experiments. The assumed dependence of the energy of a copper-zinc pair on volume is compatible with the energy as calculated from the compressibility of brass and the observed expansion.

The presence of *Zelleriella*, a minute parasite of certain toads and amphibians of South America and Australia, is reported by Dr. H. Sandon from South Africa. This parasite is not found in North Africa or Asia, and its presence in South African frogs lends support to the hypothesis of former land connexions between the southern continents.

Germinating seeds of dry barley and other cereals, etc., covered with crystals of acenaphthene for a few days, show changes in the type of their growth, according to Prof. D. Kostoff. These changes are found to correspond to abnormal behaviour of the chromosomes during the process of division of the cells. The activity of some factors responsible for the arrangement of the chromosomes during mitosis and meiosis is apparently inhibited.

Research Items

Bushmen and Hottentots

IN the course of an investigation of a quantity of skeletal material, adult and infant, from burials in the rock-shelter on Oakhurst Farm, George, Cape Province, South Africa, excavated by Mr. A. J. H. Goodwin (see page 1151), Prof. H. R. Drennan has found it necessary to define the characteristics by which the Bushman and Hottentot types are differentiated (*Trans. R. Soc. S. Africa*, **25**, 3, 1938). A comparison of the skeletal material from Oakhurst and the Matjes cave, both associated with the Wilton stone age culture, leads to the conclusion that the Hottentot, instead of being a Bushman-Bantu cross, as has been held generally, may be the product of an evolution from a 'Wilton race', the larger head and greater stature in comparison with the Bushman being an inheritance from a Boskop or Boskopoid type. The Wilton race, it is generally recognized, has strong affinities with late palæolithic man in Europe and northern Africa. As regards the special features of the Hottentot skull, as distinguished from that of the Bushman, it tends to be 5–15 mm. longer, but as there is no proportionate increase in breadth, and often a diminution, the majority are dolichocephalic, whereas a majority of the Bushman skulls are mesaticephalic. The Hottentot skull is consequently more an elongated oval than of the marked Bushman pentagonoid form. The vault is definitely higher, the breadth-height index bringing out the difference very strongly. The width of the face is only slightly greater than in the Bushman, in keeping with the narrowness of the cranium; but the length is definitely increased in relation to the length of the base of the skull, giving a downward extension of the jaw which has the appearance of prognathism, whereas it is really 'subgnathism'. The orbital index is usually lower than in the Bushman. Both races are platyrrhine. The mandible of the Hottentot is distinctive, being more massive and much longer, but it is not much wider, and therefore has a much higher mandibular index. The ramus is also more robust, and even wider in relation to the height than the Bushman ramus.

Study of Life and Climatic Relations

MISCELLANEOUS Publication No. 280 of the U.S. Department of Agriculture, dated January 1938, is a quarto brochure of 188 pages on "Bioclimatics. A Science of Life and Climatic Relations". Its author, Dr. A. D. Hopkins, was formerly an official entomologist but resigned in order to devote his time to research on this subject. The purpose of this publication is to give the results of prolonged studies made by the author on the principles of life and climatic relations, and their application to agriculture, with the hope that specialists in different sciences will adopt such as may be applicable to their own lines of work. The bioclimatic zone and zonal types of a place, area, or local region are the most reliable indexes to the species of animals and plants, and to the types of agriculture, that are best adapted to the local conditions. Under the requirements of the bioclimatic law, the phenomena of life and climate should be equal, under equal influences at the same level, across the continents along lines which depart from the parallels of latitude at the assumed constant rate of 1° of latitude and 5° of longitude. These lines are termed isophanes. Since, however, the influences of local or other factors are never equal, departures or variations of the observed effects from the requirements of the law must occur. Such variation as determined by bioclimatic methods and expressed in units of time, temperature or distance serve (*a*) as measures of the relative intensity of the modifying influences and (*b*) as indexes to the interpretation of causes and factors and to the prediction of bioclimatic elements at any given geographical position. It is stated that the laws, principles, systems and methods as outlined in these pages, taken in conjunction with the tables, maps and test examples, enable the application of bioclimatic principles to be made to many branches of economic biology and agriculture.

Immature Stages of Aquatic Diptera

PROF. O. A. JOHANNSEN completes his study entitled "Aquatic Diptera" in Memoir 210 of the Cornell University Agricultural Experiment Station, which comprises Parts 4 and 5 of the series. Part 4 deals with the large subfamily Chironominæ and Part 5 with the family Ceratopogonidæ. Many additions to knowledge of these two groups have been made in recent years, especially by European workers. The results have made it evident that in the Chironominæ the immature stages offer fewer and less sharply marked characters than do the adults, and considerable difficulty, therefore, attends the identification of these stages. In this connexion, the keys to the genera and species together with the accompanying figures of larval and pupal characters should prove a useful aid. In the Ceratopogonidæ, it will be noted, the few terrestrial forms are also included in order to make the account more complete. The part dealing with this family is written by Miss Lilian C. Thomsen.

Crustacea and Pycnogonida of the John Murray Expedition

DR. M. RAMADAN describes the Astacura and Palinura and Dr. W. T. Calman the Pycnogonida of the John Murray Expedition 1933–34 (British Museum (Natural History). Scientific Reports, **5**, No. 5 and No. 6; 1938). Only ten species of Astacura and Palinura were collected, one of which, *Puerulus sewelli*, is new. There are two appendixes to this part, one on the luminosity of Penaeidæ, in which the photophores of *Hymenopenaeus debilis* are described, and the other on the structure of the ocular peduncles in deep- and shallow-water forms of the Penaeidæ. Comparison of the ocular peduncles in deep- and shallow-water penaeids shows that the simplest form of peduncle is found in the deep-water forms, and as a rule the cornea is hemispherical, whilst a complex peduncle and reniform eye occur in the shallow-water forms. Fourteen species of Pycnogonida were obtained by the Expedition, no fewer than six of which are new. *Colossendeis angusta* from deep water in the Gulf of Aden has an extremely wide distribution, perhaps world-wide, always in cold water and (except in the Arctic) at great depths. Lieut.-Colonel Seymour Sewell is of the opinion that the two specimens captured without doubt came along with the Antarctic bottom drift up the east coast of Africa or else with the deep Atlantic water that enters the Indian Ocean round the Cape of Good Hope.

Autecology of *Zostera*

T. G. TUTIN has recently issued an interesting discussion of the growth and habitat of *Zostera* in connexion with its curious disappearance from many Atlantic localities, first from the American seaboard in 1931 and then a year or two later from its European localities (*New Phytol.*, **37**, No. 1, 1938). The plant was so reduced in many cases as to affect seriously the distribution of other marine life, such as fishes and wild game birds; in Canada alone the annual financial loss from its reduction was conservatively estimated at some £30,000. Two parasites have been identified in the diseased patches in both America and Europe, a *Labyrinthula* and a fungus *Ophiobolus halimus*, but Mr. Tutin's conclusion is that these parasites have probably been generally present and cannot be assigned a major role in the widespread disappearance of the plant. He points out that the sunshine deficiency in the year 1931–32 in the British Isles amounted to some 20 per cent below normal, that no year in the previous ten years showed a deficiency approaching this and that the plant as a result was less vigorous and succumbed more readily to parasites that were always present. The widespread disappearance on the American seaboard at almost the same time is regarded rather as a coincidence than as evidence of the operation of a parasite the activities of which have spread a year later across the Atlantic. Recovery may depend upon seed propagation, as seedlings are free from the parasite and may be expected in that case to be slow in many localities where temperature conditions especially are not favourable to flowering, seed production and germination. The same causes might explain the fact that the plant still flourishes in its Mediterranean localities, for there the habitat is suitable to propagation by seed.

Growth-Promoting Substances in Horticultural Practice

A VERY useful paper by Dr. M. A. H. Tincker (*J. Roy. Hort. Soc.*, **63**, Pt. 5, 210; May 1938) gives timely results of a number of growth-promoting substances upon the rooting of a wide variety of cuttings. β-indolyl acetic acid, α-naphthalene acetic acid, phenyl acetic acid, iso-indolinone and indolyl butyric acid have been used, and various methods of application have been tried. The most suitable treatment appeared to be the standard method of placing prepared cuttings with their bases in a solution of the substance for 24 or 48 hours. A certain amount of success was also obtained by the application of solutions to the rooting medium. The use of lanolin pastes containing the growth-promoting substances was deemed unsuitable for garden routine, though useful for unilateral application in experimental work. An interesting fact is that the polarity of root cuttings of *Anchusa italica* was influenced by treatment with α-indolyl acetic acid, and the results in general show a useful increase in facility or strength of rooting. Extensive though this paper is, the results require to be multiplied exceedingly. Dr. Tincker reports, for example, considerable success with ten varieties of *Pelargonium zonale*, following treatment; but the increasing experience of gardeners suggests that *Pelargonium* varieties respond somewhat irregularly to treatment with growth-promoting substances, and it is conceivable that with further varieties, or with other substances, Dr. Tincker would have had different results.

A Smut Disease of Brassicaceous Crops

CABBAGES and allied plants are subject to several destructive diseases, but yet another pathogenic fungus has recently been added to the list. Dr. B. B. Mundkur describes (*Phytopath.*, **28**, No. 2, 134, Feb. 1938) a new smut fungus from India. The species is *Urocystis brassicæ*, and although it is somewhat similar to *U. coralloides*, described by Mitra upon mustard, it is described as a new species by reason of its different spore size, and its dissimilar host range. Radish, turnip, cabbage and other related plants are attacked, and the fungus induces galls upon infected roots. The smut is soil borne, and brings about considerable reduction in yield.

Olivine-Fourchites from Antarctica

IN the course of an exploratory expedition from the base camp of the Byrd Antarctic Expedition II, an extinct volcano was discovered in the Raymond Fosdick Mountains. The specimens representing the lava flows, all of which are olivine-fourchite, have formed the subject of a petrological study by C. N. Fenner which is of exceptional interest and significance (*Bull. Geol. Soc. Amer.*, **49**, 367–400; 1938). The physical and mineralogical structure of the rocks made possible the separation of the phenocrysts—olivine and pyroxene—from the ground-mass. Analyses of these three products have been made and with the resulting information it has been possible to compare the actual course of crystallization of the magma with what has been deduced from theoretical considerations. The ground-mass has been found to have an ultra-basic composition. This leads to the conclusion that, contrary to inferences reached in the theory of crystal fractionation, wholly liquid magmas of ultra-basic composition can exist. In this connexion it is of interest to note that in a recent presidential address N. L. Bowen has admitted that "difficulties accumulate for him who questions the existence of anchi-monomineralic magmas" (*Am. Min.*, 129; 1938). Fenner has also found that in passing from phenocrystic pyroxene to ground-mass pyroxene, there is decrease of SiO_2 and MgO accompanied by increase of Al_2O_3, iron oxides and CaO. These results do not seem to be in accord with generalizations from experimental work on silicate systems, such as have been used to support the theory of crystallization differentiation. It is pointed out that the final test of conclusions regarding magmas lies in the behaviour and properties of the magmas themselves and of their actual minerals, and that this test should be applied in a more rigorous manner. Inferences from the behaviour of simple laboratory melts should not be generalized to cover conditions to which they may not be applicable.

Phosphors Without Metallic Activator

THE fluorescence of teeth suggests the existence of a type of fluorescent substance different from the more familiar phosphor resulting from firing a salt with a small amount of foreign metal as activator. W. H. Byler (*J. Amer. Chem. Soc.*, **60**, 1247; 1938) has prepared phosphors from several inorganic compounds and mixtures without the use of metallic activators, for example, by treating calcium phosphate with phosphoric acid and firing at 400°. Pure basic and acid phosphates of calcium show fluorescent intensities of only 2 and 3 on an arbitrary scale after

optimum heat treatment at 400°, but a correct mixture of the two develops an intensity of 10 when similarly treated. Phosphors developed from mixtures of calcium phosphate with certain organic compounds such as tartrates were also studied. Since teeth are made up largely of calcium phosphate in the apatite structure and contain about 1 per cent of organic matter, it is considered that their fluorescence may be due to this type of complex. The general conclusion is reached that, in the absence of a specific metallic activator, fluorescence resulting from heat treatment of inorganic compounds is due to the formation of complexes of critical composition through partial decomposition, or of critical physical condition through modification of crystal structure.

Phenazine Derivatives

A NEW species of bacterium which has been named *Chromobacterium iodinum* isolated at the National Institute for Research in Dairying at Reading produces a violet, copper-glinting pigment outside the organism at the later stages of its growth. This pigment has been examined by G. R. Clemo and H. McIlwain of King's College, Newcastle-upon-Tyne (*J. Chem. Soc.*, 479; 1938), and found to be a phenazine derivative of formula $C_{13}H_8O_4N_2$. On reduction, it yielded a compound, $C_{13}H_{10}O_2N_2$, in which two atoms of oxygen in the original compound are replaced by hydrogen. Since no product of biological origin has yet been obtained with a nitro-group (NO_2, which would reduce to NH_2) and the reduction product is readily converted on crystallization to $C_{13}H_8O_3N_2$, the interesting conclusion is reached that the pigment is 1:2-dihydroxyphenazine di-N-oxide, a derivative of the hitherto unknown phenazine di-N-oxide. Other derivatives of this have been prepared, and the synthesis of the purple pigment is to be attempted. The phenazine compounds which have been isolated from natural sources are now three in number, namely, pyocyanine, chloraphine and the present pigment. These are all bacterial pigments, but phenazine compounds have been shown to exhibit biological activity in a variety of organisms and enzyme systems, and it is anticipated that phenazine derivatives will be found much more widely distributed in Nature.

American Steam-Distilled Wood Turpentine

INTER-STATE regulations governing commerce in steam-distilled wood turpentine and gum spirits have emphasized the need for a satisfactory method of distinguishing these two products. Actually they are both derived from the same species of pine, though the former is prepared from stump oleoresin and the latter from fresh gum. Different methods are also employed for their preparation. Even so, continued improvement in the process of refining steam-distilled wood turpentine has made their distinction less and less easy. The United States Department of Agriculture has recently published a Bulletin (No. 596, December 1937) describing a suitable technique for the examination of such products and summarizing the chief differences between steam-distilled wood turpentine and gum spirits discovered by the application of this technique. In short, this process, which consists of systematic fractional distillation, has revealed that the hydrocarbon components of gum spirits consist practically entirely of dicyclic terpenes, whereas those of steam-distilled wood turpentine consist of appreciable proportions of monocyclic terpenes. There is a considerably larger proportion of the dicyclic terpene α-pinene in steam-distilled wood turpentine than in gum spirits. The quantity of β-pinene present in gum spirits is substantial while that in steam-distilled wood turpentine is negligible.

Critical Phenomena in Gases

RECENTLY, three papers by Prof. J. E. Lennard-Jones and A. F. Devonshire have appeared dealing with critical phenomena in terms of interatomic forces (*Proc. Roy. Soc.*, A, **163**, 53 (1937); **165** (1938); *Physica*, iv, **10**, 941 (1937)). An atom in a dense gas is assumed to be confined for the greatest part of its time to a cell, and consequently its average environment closely resembles that of an atom in a liquid or in a crystal. Instead of trying to calculate the properties of such a dense gas from binary encounters, the atom is considered to be subjected continually to multiple encounters. On this basis, by an application of the methods of classical statistical mechanics, an equation of state is derived and values of the critical temperatures of hydrogen, neon, argon and nitrogen are calculated; these values agree well with those observed. An extension of the method to liquids makes it possible to calculate boiling points in terms of interatomic forces; those calculated for neon, argon and nitrogen agree well with observed values. In addition, a theoretical interpretation is given to Trouton's rule and to the modified form of it suggested by Hildebrand. Calculations of the vapour pressures and heats of vaporization of the inert gases have also been made.

Wave Mechanics and Stellar Statistics

THIS is the subject of an interesting investigation by Dr. H. Jehle, University College, Southampton (*Z. Astrophys.*, **15**, 182; 1938). Jehle deals with the statistics of an assembly of macroscopic mass-points by means of a generalized wave mechanics in ordinary space time. The wave equation differs from Schrödinger's equation only so far as h/mc is replaced by a macroscopic length σ which is characteristic for the assembly in question. Indeed, such a Schrödinger equation can be split into a continuity equation and in a Hamilton-Jacobi equation; and these on the other hand, can be identified with the continuity equation and the Hamilton-Jacobi partial differential equation for the streaming field of a statistical distribution of mass-points. Thus the classical laws of motion are not modified, unlike the case of a single particle in ordinary wave mechanics, but the assumption is introduced that in this assembly the product interval of position times interval of velocity is greater or equal to $\sigma.c.$ This is in particular an assumption about the peculiar velocities. This theory has originally been designed for big stellar systems, and it offers an explanation of the following problems: the 180°-symmetry and the very slow development of the structure of spiral nebulæ; the greatest possible flattening and the average mass density in nebulæ. In the case of the solar system an application of the wave mechanical perturbation theory explains the distribution of the major axes of the planets that is, Bode's law, as well as the exceptions to it (Neptune), and the corresponding distributions in the systems of the moons. The well-known resonance relations between the periods of revolution are given by similar considerations, being in close correspondence to the classical theory of resonance.

The Physical Society

Cambridge Meeting

THE Physical Society has developed the custom of holding at least one of its meetings each session in some centre outside London, and on June 18, through the kindness of Prof. E. V. Appleton, acting director of the Cavendish Laboratory, the meeting was held at Cambridge. About two hundred fellows and their guests attended.

The morning was spent in visits to the Cambridge Press, where Mr. Lewis and his staff did everything possible to make the technical side of printing as clear as possible, or to the Cambridge Field Station of the Radio Research Board, or to the works of the Cambridge Instrument Co., Ltd. Here both the works and the research section were on view, and members and their friends appear to have been particularly impressed by a device for measuring the thickness of sheets of non-magnetic material, which functions without the necessity of access to both sides.

The visitors to the various exhibits assembled at St. John's College for lunch, where the guest of honour was Sir J. J. Thomson. Speeches were short, but the president, Prof. Allan Ferguson, expressed the pleasure of the Society at the presence of Sir Joseph, the sympathy with Cambridge—and corresponding congratulations to Teddington—at the translation of Prof. R. H. Fowler, and a sense of satisfaction with the recognition (by the award of an O.M.) of the work of Sir Arthur Eddington, as well as the sincere thanks of the guests to the Master and fellows of St. John's for allowing them to lunch there. In his reply "J. J." expressed his relief that the finances of the Cavendish Laboratory were no longer his responsibility, and delighted all physicists by the announcement that he has again taken up experimental work there.

The Society devoted the afternoon to a meeting and an inspection of the laboratories, whilst through the kindness of Mr. Barnard, secretary of the Cambridge Antiquarian Society, those whose interests lie outside physics were enabled to enjoy a tour of the colleges, meeting the main party at tea, and thus at any rate seeing one room of the Cavendish Laboratory.

The proceedings at the meeting were opened by Prof. Appleton, who pointed out that one of the main interests of the Laboratory had always been the structure of matter, and mentioned that when Prof. Bragg assumes the professorship in October, he will bring with him the subject which he has built up for himself, and will contribute, from a different aspect, to the studies already in progress there. On the subject of radio research, he explained the frequency modulation method, and showed results obtained on the direct observation of interference fringes in space between the ground wave and the reflected wave. He also dealt with the peculiar fact that during anomalous periods, the absorption of short waves is diminished at the same time as that of long waves is increased, the explanation being that the increased ionization at these times makes the reflecting layer more perfect for short waves, which are reflected without much penetration, but that long waves are absorbed because they travel farther into the layer. The connexion with sunspots was also expounded, and the problem of why some are associated with high ionization and some are not was mentioned, but left as one of the as yet unsolved problems.

Prof. Appleton was followed by Dr. J. D. Cockcroft, who explained the low-temperature equipment at Cambridge, and described the anomalies of liquid helium II in viscosity and thermal conductivity. He mentioned that the helium liquefier, which functions without pre-cooling with liquid nitrogen, begins to condense helium in about two hours from starting, and then has a yield of about 2 litres per hour. Next he described the cyclotron, and the story of the work on nuclear physics was carried on by Mr. P. I. Dee, who gave an account of some of the more recent work carried out at Cambridge in this fundamental subject.

After the formal meeting, parties were conducted around the Cavendish and Mond Laboratories, where the various research equipment was shown by workers who had generously given up their Saturday afternoon leisure in the general desire to make the visit as pleasant and enjoyable as all the visitors seem to have found it.

New Science Block at Malvern College

EARL BALDWIN OF BEWDLEY, who has been a member of the Council of the College for many years, opened the new Science Building at Malvern on Saturday, June 18, in the presence of a large company of Old Malvernians, parents and friends of the school. Dr. G. D. Bengough, who left Malvern in 1895, was there, but Malvern's only Nobel prizewinner, Dr. F. W. Aston, was unable to be present.

The building is to be known as the Preston Science School, after the head master, Mr. F. S. Preston, who retired in 1937, at the end of whose tenure of office the building was erected. Before opening the building, Earl Baldwin paid a tribute to Mr. Preston's work at Malvern through twenty-three years, to his high personal qualities and to his breadth of judgment in providing the School with the best equipment available for the teaching of science.

The new building has three floors, which are sound-proof. The ground-floor is devoted to the teaching of chemistry, and consists of three teaching laboratories and a large lecture room, capable of seating sixty, together with ample storage space and a laboratory attendant's room. Heating is by radiation

from panels concealed in the plaster of the ceiling. Ample fume-cupboards, worked by suction-fans on the roof of the building, are provided. There is a vacuum installation with fourteen points in the different rooms and a hot-water supply to certain sinks.

The advanced chemistry room has desk accommodation for twelve and is to be used both for practical work and for lecturing to small classes of senior boys. There is a glass-working table and a large ventilated combustion-hood, fittings which are also present in the large Fifth Form laboratory. The elementary laboratory has desk accommodation as well as bench space for twenty-four boys. The lecture room has a fume-cupboard, an epidiascope and a fixed mirror-galvanometer with ground-glass scale, the leads being taken to terminals on the lecture bench.

Photo] [*Norman May, Malvern*

PRESTON SCIENCE SCHOOL, MALVERN COLLEGE.

The first floor is intended for the teaching of physics. There are three teaching laboratories, an optical dark room, a photographic dark room which is very fully equipped, a workshop with rectifier plant, a smaller lecture room and a room for storage on this floor. The lecture room has an equipment similar to that of the room on the floor below, except that in addition there is a transformer for supplying an alternating current arc. The advanced laboratory has slate shelves built into the walls for supporting instruments which must be protected from vibration, and a beam is built into the angle of the walls for Young's modulus experiments. All the physics rooms have a variety of benches and tables to which gas, electric light and power are supplied. The surfaces of the tables are free from taps or any other obstruction.

The second floor has four rooms in all, two of which are designed for the teaching of biology. One of them is fully equipped for lecturing and dissection, there being a particularly useful device for washing and cleaning dissecting boards. The other room is arranged primarily for botanical work. These two rooms are connected by a small preparation and store room. A third room on this floor contains four aquaria, a large sink, working benches, drawers, shelves and bookcases; it is to be used by boys interested in natural history, for arranging, investigating and storing their specimens. The remaining room, which is furnished as a library, contains about six hundred scientific books and many periodicals.

The architects of the building were Messrs. George Hubbard and Son, of 45 New Bond Street, London, and the fittings were designed by Messrs. Munby and Smith, of 9 Old Square, Lincoln's Inn, London.

The Structure of Benzene*

FOR many years attempts were made to explain the peculiarities of aromatic compounds by making various special hypotheses relating to the benzene nucleus. It is a satisfactory feature of the present situation that the theory of benzene is simply a special—and specially important—case of an established general extension of valency theory, and that this extension uses essentially the same physical principles as are applied in the interpretation of valency itself. These are the postulates of the 'new' quantum theory (fundamentally the principle of complementality), which provide at once a physical basis for the forces of valency, and for such departures from the ordinary valency rules as are illustrated so strikingly in the parent of the aromatic series.

From an experimental point of view, we are concerned to establish the correct stereochemical model for benzene, and to discover, also in a quantitative way, as much as possible about the internal forces which maintain that model. Theory creates a predilection for a model of plane, regular hexagonal symmetry, because theory works out most simply if such a model be first assumed. The available experimental methods for the determination of a molecular model are (1) by X-ray or electron interferometry, (2) from rotation-vibration or vibration-electronic spectra. The interferometric method indicates the plane, regular model to a rather close degree of approximation, but the spectroscopic method, which is particularly sensitive, and eminently suitable for application to this problem, was at first claimed to establish a contrary conclusion. For this

* Substance of the Bakerian Lecture to the Royal Society, delivered by Prof. C. K. Ingold, F.R.S., on June 16.

reason, and also because the spectroscopic method, by giving vibration frequencies, supplies direct information about the internal forces, this method has been recently pursued by Angus, Bailey, Wilson and others; and it has been employed in relation not only to ordinary benzene, but also to benzenes in which a part or the whole of the hydrogen is present in the form of deuterium.

This use of deuterium greatly increases the amount of information obtainable from the spectra; for isotopic substitution leaves the whole force-system of the molecule unchanged, wherefore the vibrations which are responsible for the observed frequencies can be identified by comparing the frequency shifts caused by isotopic substitution with those calculated from the known changes of atomic mass under the assumption of unaltered forces (Teller). Four spectra are studied: Raman scattering, infra-red absorption, ultra-violet fluorescence, and ultra-violet resonance emission. All give information concerning the molecular form and vibrations of the ground state of the molecule. Five benzenes have been examined moderately completely, whilst two others (formulæ in parentheses) are under examination: C_6H_6, C_6H_5D, $1:4\text{-}C_6H_4D_2$, $1:3:5\text{-}C_6H_3D_3$, $(1:2:4:5\text{-}C_6H_2D_4)$, (C_6HD_5), C_6D_6.

By a comparison of frequency shifts and other spectroscopic characteristics amongst the spectra of these compounds, the frequencies of a large number of vibration-forms have been identified. From this information, with the aid of spectroscopic rules which depend ultimately on a consideration of the physical mechanism of production of the various spectra, it is possible unequivocally to establish the plane, regular model for the isolated (gaseous) benzene molecule. The previously claimed contrary indication is explained as due to the use (or accidental presence) of liquid, wherein the intermolecular forces are sufficient to deform the molecules to a spectroscopically significant extent. An approximate specification of the internal forces could be made at present, but in order to render such a specification complete with respect to harmonic forces, we require further identified frequencies, wherefore the extension involving $C_6H_3D_4$ and C_6HD_5 is necessary.

A Stone Age Rock-Shelter in South Africa

OAKHURST rock-shelter, situated in an enclosed valley on a farm thirteen miles east of the town of George, Cape Province, South Africa, four miles from the Indian Ocean, and two from the coastal lakes, has been excavated by Mr. A. J. H. Goodwin (*Trans. R. Soc. S. Africa*, 25, 3; 1938). Between February 1932 and February 1935, six visits were paid to the cave, varying in duration from a month to a week, during which the excavation was carried out.

The shelter, which is some sixty feet in length and about twenty-five feet deep at surface level, is divided into two parts. Of these, the inner is separated from the outer and southern portion by a hanging buttress of rock. There is a talus on the southern and eastern sides. The inner portion of the shelter has been left undisturbed for future examination. It is anticipated that much richer deposits will be found here, judging from the midden material which had washed out under the buttress. The outer portion has been excavated down to the base of the deposits. These were of considerable thickness, the total depth excavated being one hundred and twenty-six inches.

The shelter is situated in a dense forest, about twenty feet above a stream in a high sandstone overhanging cliff of schistose quartz-bearing sandstone. It is approached by an old elephant path. Nearby were rock paintings in red, partially obliterated and not clear enough to photograph, and game pits.

A large amount of skeletal material was found in the deposits. The bones had been much disturbed by root action; while digging for subsequent interments had frequently interfered with earlier burials. It was, therefore, possible to distinguish with certainty eighteen graves only. There had been many more, but the contents were commingled, and at times it was difficult to distinguish grave furniture from introduced material. The skeletal remains had also suffered much from the pressure of gravestones. The greater number of burials occurred at a depth of between fifty and sixty inches from the surface, while a space of some seven by five feet included more than half the graves. As the later people buried at a depth of thirty inches, and the earlier at a depth of fifteen inches only, the graves for the most part occurred at approximately the same level.

The major part of the deposits consists of decayed vegetable matter with a high percentage of wood ash. In addition there are vast quantities of shell present throughout the deposit, this in the upper layers constituting a great part of the bulk. Until the deposits had been built up to some height the shelter could not have afforded much protection against the weather. Hence in the early layers there is evidence of temporary occupation only—the remains of one-night fires and burnt bones. With the advent of Smithfield *B* man, occupation takes on a more permanent character. The prevailing stone used by all the occupants of the cave was white quartz, probably from a vein of quartz, one hundred yards away, which has been quarried. Chalcedony and agates were also used, brought from neighbouring beaches.

The uppermost three feet of the deposit consists generally of Wilton material. In the top nine inches only was pottery, below this at a depth of thirty-six inches was a normal Wilton culture, in which stone crescents in white quartz and chalcedony are common. Following this short normal phase (that is, above it), comes a long period in which shell crescents (*Mytillus edulis*), the first shell implements to be described in South Africa, take the place of stone. Apart from this diversion from stone to shell, there is little change, save for the addition of pottery in the latest phase.

Among the ornaments nacre was rare; but vast numbers of ostrich-shell beads were retrieved. In addition there was a single cowrie shell, and a number of naturally bored shells had been brought to the cave, presumably for ornaments. A hippopotamus tusk and one ivory bead were found, as well as

borers, arrow points, and tubes of bone. Fish bones, scarce at the beginning of this period, were found in large quantities in later levels, pointing to the development of a considerable competence in fishing. Banked ash at the southern end indicated a protection fireplace, dividing the cave shelter into two compartments, one for general purposes and one for sleeping.

Below the thirty-six inch level Smithfield *C* material extends down to a depth of sixty inches, the richest level being between thirty-six and fifty-four inches. Throughout the deposit only implements of the general scraper type could be recognized with certainty. More than five thousand scrapers in white quartz were collected from the Smithfield deposit. There were as well two hundred flakes of brown chalcedony. The quartz flakes, almost a solid mass, in parts up to two feet in depth, indicated that the shelter at this period must have been a workshop. Throughout this deposit ostrich shell beads in large numbers were found, but nacre ornaments are rare.

At the base of the Smithfield *C* deposit between two buffer layers was a carbon floor or layer, representing a period of peculiarly fierce forest fire, which was presumably the cause of the desertion of the cave by the Smithfield *B* people. The Smithfield *B* culture extended from a depth of sixty inches down to seventy-seven inches or more in parts. It is to be remarked that there is no great difference to be observed between the implements from above and below the carbon floor. The variation is rather one of size, or in distribution of sizes. The scrapers, for example, are much larger. All implements are still of the general scraper family. The deposit as a whole is far less rich than the Smithfield *C* layer and represents the normal debris of a home site. The major part of the material is quartz, chalcedonic quartz being rare and brown chalcedony absent. One end scraper is of fossilized wood from the Tertiary Enon beds. A Mossel Bay point and a Still Bay type mark the overlying deposit as post-dating the "Cape Flats complex".

Below seventy-seven inches evidence of the sterile character of the lower deposits begins to become apparent. In one section a few good Smithfield *B* specimens still appear between the eighty-four and ninety inch levels; but below ninety-six inches formal implements disappear. In the underlying material there are only scattered hearths with burnt bones and quartz split by fire or broken by man, but no implement types that could be recognized. Though there are suggestions of Middle Stone Age technique on some of the flakes, these must be ignored, as deduction from the sugary quartz would be impossible to maintain. There is, however, evidence to show that use was made of the shelter for a very considerable period before Smithfield *B* man appears.

The pottery has been submitted to a careful and detailed analysis by Mr. J. F. Schofield, who terms it "Hottentot", and suggests that its specific characters, lugs and an occasional oval section, are an adaptation to the use of the pack-ox by a nomadic people.

The skeletal material has been studied by Prof. M. R. Drennan, whose detailed report deals with the relation of the Oakhurst people to the Wilton race and the Hottentot. The skeletal material shows that these people had many Bushmen characters, but they were of a special type, being much taller and more robust, with bigger heads. They resembled the type to which the term 'Hottentot' has been applied—a term which accordingly has to be defined (see NATURE, p. 1146). The main conclusion is that the Boskop type must be regarded as the ancestor of the Hottentot. The infantile material, which is the first series of any extent to be examined systematically, has provided data for a study of growth in infancy.

Submarine Light Measurements

AT the meeting of the International Council for the Exploration of the Sea held at Copenhagen on May 23–28, a special session was devoted to submarine light measurements. H. H. Poole gave a brief summary of the results obtained by different workers on the variation of surface loss with weather conditions, pointing out the difficulties involved and stressing the importance of further work on the effect of surface conditions on the angular distribution of submarine daylight.

H. Pettersson described the work of himself and his co-workers on the angular distribution at depths of 5 and 10 m. below a smooth water surface. Their measurements showed that, with the sun shining, the illumination was chiefly concentrated within a comparatively small solid angle round the calculated path of a ray of sunlight, as refracted by a smooth surface, the direction of maximum illumination being slightly nearer the vertical at 10 m. than at 5 m. From these results it is possible to calculate the ratio of the total illumination (as measured by a photometer with a spherical receiving surface) to the vertical illumination (as recorded by a plane photometer with its window horizontal). This is important, since the former is the governing factor in photosynthesis, and the latter is usually measured. The values found for the ratio total/vertical ranged from about 1·5 with the sun at 20° altitude to 1·35 with diffuse daylight.

M. Graham described measurements of the opacity of the water at 44 stations in the North Sea made by (*a*) the Lowestoft absorption photometer, (*b*) measurements of the percentage of daylight at a depth of 10 m., and (*c*) Secchi's disk. For finding the origin and history of the water masses involved he considers that the use of Secchi's disk has much to recommend it, but that the most promising method is that of Pettersson's transparency meter, in which an artificial light source and a photo-electric cell are used at any required depth.

E. K. Gabrielson and E. Steemann Nielsen reported experiments on the photosynthesis of various diatoms in light of different colours. Their results showed that for a given amount of energy violet-blue light produced about twice as great assimilation of carbon dioxide as either yellow-green or orange-red, the latter spectral regions being about equally efficient.

The special sub-committee on the standardization of photo-cells for daylight measurements held several meetings, and hopes soon to be in a position to undertake this standardization in energy units for different spectral regions.

Science News a Century Ago

Beginnings of the Gas Industry

ON June 28, 1838, the chemist Friedrich Christian Accum died in Berlin at the age of sixty-nine years. He was born on March 29, 1769, at Buckeburg, Westphalia. At twenty-four years of age, he came to England and for nearly thirty years made his home at 11 Compton Street, Soho, London. He was well-known as a lecturer, and is remembered to-day for his share in the founding of the gas industry and his books on practical chemistry. He first made a mark with his book on "Theoretical and Practical Chemistry" published in 1803. This was followed by a "Treatise" and a "Manual" on the analysis of minerals, and his book on "Crystallography", of 1823, the first in English based on Haüy's epoch-making work. By this time he had become interested in coal-gas lighting. He carried out some of the earliest experiments for the Gas Light and Coke Company, gave evidence on its behalf before a committee of the House of Commons and in 1812, when the Company was granted its charter, he became one of the directors. He undertook to supply plans and estimates for gasworks, and installed gas-lighting for the Government at the Royal Mint. These occupations led him to write his two books, a "Practical Treatise on Gas-Light" (1815) and a "Description of the Process of Manufacturing Coal-Gas" (1819), both of which were widely read in Great Britain and abroad, contributing much to a general knowledge of the new method of illumination.

Chemistry of Foods

ACCUM was also known for his books on the chemistry of foods published in 1820–21. The first of these was his "Treatise on the Adulterations of Food, and Culinary Poisons", of which 4,000 copies were sold in a year. On the cover was a representation of a skull and cross bones and the legend, "There is death in the pot. II Kings, c. 4 v. 40", leading to the book being popularly called "Death in the Pot". This was followed in 1821 by a "Treatise on the Art of making good wholesome Bread, etc.", a "Treatise on the Art of Brewing" and "Culinary Chemistry, exhibiting the Scientific Principles of Cookery", probably the first English book of its kind. For some time, Accum was a member of the Royal Institution, the Linnean Society and the Royal Irish Academy, and was well known for his lectures at the Surrey Institution, which had been founded in imitation of the Royal Institution, for the south of London. The Institution occupied the buildings close to the Thames near old Blackfriars Bridge, which once housed the Leverian Museum. The Institution was in existence from about 1806 until 1823, but before it had closed its doors Accum had returned to Germany. In 1820 he was suspected of removing pages from scientific works at the Royal Institution and a search warrant having been obtained he was charged at Bow Street. The magistrate, however, discharged him. The managers of the Royal Institution then indicted him before the Westminster Assizes. Pleading not guilty, his case was allowed to stand over until the next sitting of the court, but Accum failed to appear. He had returned to Berlin, where in 1822 he was given a post at the Technical Institute. At Berlin too he published a work in two volumes on the "Properties of Building Materials". Several of his books were published in London by his fellow-countryman, Rudolph Ackermann (1764–1834), whose premises in the Strand, London, were among the first to be lighted throughout by gas.

The Salamander

IN its issue of June 30, 1838, the *Athenæum* had the following note: "M. Paravez has written to the French Academy of Sciences that a fossil Salamander in the collection of Prof. Van Breda, at Leyden, about three feet long, contains in the part corresponding with the abdomen, the fragments of frogs, eels, etc., thereby affording a proof that antediluvean species fed upon the same substances as the Salamanders of our own time. A large Salamander brought by M. Siébold from Japan, still lives in the museum at Leyden, which is principally fed upon frogs. This Salamander is described in a Japanese Encyclopædia, and M. Paravez finds in this work the same fables which exist in Europe concerning the animal, namely, its insensibility to fire. The same stories concerning the chamelion are also found in the Encyclopædia, and bring further conviction to M. Paravez, that a very ancient centre of civilization has existed, whence come the ideas concerning art and science, which have been transmitted to us by the Greeks and Romans, and which are also to be found in Chinese books."

University Events

EDINBURGH.—Prof. J. Bertram Collip, of the Department of Biochemistry in McGill University, Montreal, who was awarded the Cameron Prize for 1937, delivered the prize address on "Results of Recent Studies on Anterior Pituitary Hormones" on June 16.

LEEDS.—At a Congregation to be held on July 4, the following honorary degrees will be conferred, among others: D.Sc. on Prof. Alfred Fowler, emeritus professor of astrophysics in the Imperial College of Science and Technology, and Mr. C. J. T. Cronshaw, managing director, Imperial Chemical Industries (Dyestuffs Group).

MANCHESTER.—Dr. A. R. Todd, of the Lister Institute, and reader in biochemistry in the University of London, has been appointed Sir Samuel Hall professor of chemistry and director of the Chemical Laboratories in succession to Prof. I. M. Heilbron, who is taking up the chair of organic chemistry at the Imperial College of Science and Technology, London.

OXFORD.—In Convocation on June 22, honorary degrees were conferred on the following, among others: D.C.L., Sir James Irvine, vice-chancellor and principal of the University of St. Andrews, Lord Desborough, and Miss Eleanor Rathbone, M.P.; D.Sc., Prof. G. I. Taylor, Yarrow research professor of the Royal Society; D.Litt., Prof. S. A. Cook, reguis professor of Hebrew in the University of Cambridge.

Dr. M. Cattle has been appointed tutor in natural sciences at St. Hilda's College.

S. Wylie, New College, research scholar in mathematics in the University of Aberdeen, has been elected to a lectureship (the equivalent of a research fellowship) at Christ Church.

Prof. J. B. S. Haldane has been awarded the Weldon Memorial Prize for 1938.

Societies and Academies

London

Royal Society (*Proc.*, A, 166, 325–449, June 3, 1938).

S. RAMACHANDRA RAO and S. SRIRAMAN: Diamagnetism of cadmium.

C. F. GOODEVE and L. J. WOOD: Photosensitivity of diphenylamine-*p*-diazonium sulphate by the method of photometric curves.

A. J. BRADLEY and A. TAYLOR: An X-ray study of the iron-nickel-aluminium ternary equilibrium diagram.

F. W. JONES and C. SYKES: Atomic rearrangement process in the copper-gold alloy, Cu_3Au (2).

MAX BORN and KLAUS FUCHS: Statistical mechanics of condensing systems.

C. L. SMITH and W. Y. CHANG: An accurate determination of the range-distribution curve of the radioactive α-particles from ^6Li.

HANS MUELLER: On the theory of scattering of light.

Paris

Academy of Sciences, May 2 (*C.R.*, 206, 1273–1332).

V. A. KOSTITZIN: The differential equations of the problem of natural selection in the case of the mutation of a sex chromosome.

FRÉDÉRIC ROGER: The indetermination of analytical functions at their critical points.

HENRI PAILLOUX: The dynamical study of a problem of kinematics.

MAX TEISSIÉ-SOLIER and LOUIS CASTAGNETTO: The determination of the criterion of alternating vortices and the oscillations of relaxation.

JEAN LOUIS DESTOUCHES: The notion of the corpuscle. Application to the heavy electrons.

ERNEST BAUMGARDT: The transparency of solid plates to ultra-sounds. Measurements of the transparency of soft iron disks of different thicknesses to ultra-sounds produced by a quartz emitter lead to a value for Young's modulus agreeing with that determined by the statical method.

PIERRE VERNOTTE: Properties of the Fourier solution in complex systems: application to the distribution of a (heat) flux between bodies in contact.

HENRI BIZETTE and BELLING TSAÏ: The magnetic susceptibility of liquid nitric oxide, NO. The magnetic susceptibility was found to be $3{\cdot}53 \times 10^{-4}$ per cubic centimetre. From this, it is concluded that about 97 per cent of the molecules are polymerized, as against 93 per cent deduced from measurements of the magnetic rotatory power.

THÉODORE KAHAN: The potential barrier in nuclear mechanics and the nuclear dimensions of heavy radioactive bodies.

MARCUS BRUTZCUS: The *a priori* calculation of the calorific powers of hydrocarbons.

ANTONIN ANDANT: The automatic photography of the Raman spectra of liquid mixtures. Application to quantitative determinations. The apparatus described secures that the times of exposure shall be rigorously equal and that the source of light shall remain constant. With this apparatus eight spectra given by the same liquid were absolutely identical.

HENRY CASSAN: The reaction of formation of gas in a producer outside conditions of equilibrium.

MME. JULIETTE GAVORET: The isoelectric point of cellulose. Adsorption and swelling.

HENRI GUÉRIN: Study of the system As_2O_5, BaO, H_2O at 17° C. Characterization of a new barium arsenate, $BaO.2As_2O_5.3H_2O$.

MAURICE GIRARD: The semicarbazone and thiosemicarbazone of *p*-methoxyphenylpyruvic acid. The corresponding dioxytriazine and sulphoxytriazine.

RENÉ JACQUEMAIN and MLLE. GEORGETTE DEVILLERS: Some aminobenzoic esters of ethanediol and propanediol.

PANOS GRAMMATICAKIS: The action of mixed organo-magnesium compounds on the phenylhydrazones of trialkylacetophenones.

MARC BASSIÈRE: The structure of sodium isocyanate. Results of X-ray study of the crystalline salt. The structure is completely analogous with that of sodium nitride (hydrazoate). The arrangement of the atoms of the isocyanic group confirms the formula O=C=N—.

MAHMOUD GHALI and ROBERT BUREAU: The proportion of mud in the waters of the Nile, their level and recording at a distance.

PAUL BERTRAND: The successive appearance of the vascular plants and their instantaneous adaptation.

M. and MME. FERNAND MOREAU: New observations on the hormone formation of the perithecia in the Neurospora.

ROGER ULRICH: The comparison of the accumulated lipids in the green pericarps and in the albumen of the seeds of the ivy (*Hedera Helix*).

LOUIS MAUME and JACQUES DULAC: The maintenance of the chemical individuality of the stalk and ear in wheat, at definite physiological stages and in different varieties and media.

MLLE. MARIE THERÈSE FRANÇOIS: The characters of oils from aleurites and their relations with the methods of preparation.

M. and MME. PIERRE ALLORGE: The presence of epiphyllous liverworts in the islands of the Azores.

PAUL ANCEL and PIERRE VINTEMBERGER: The factors of the determinism of bilateral symmetry in the egg of *Rana fusca*.

ETIENNE BURNET and JEAN DEBIESSE: The diagnosis of species of the genus *Brucella* by the absorption spectrum of culture broths.

JEAN VIEUCHANGE and MLADEN PAÏC: The action of ultracentrifugation on the neutralizing antibodies of antivaccinal immunosera.

Amsterdam

Royal Netherlands Academy (*Proc.*, 41, No. 4; 1938).

H. A. BROUWER: Preliminary remarks on geological investigations in the Lesser Sunda Islands near Australia.

M. W. WOERDEMAN: Inducing capacity of the embryonic eye. A contribution to the elucidation of this problem by bringing optical vesicles of different ages (cf. *Axolotl*) in contact with ectoderms of different stages of development.

J. G. VAN DER CORPUT: (1) On two, three or four prime numbers (5). (2) Contribution to the additive theory of numbers (2).

R. WEITZENBÖCK: On trivectors (6).

H. R. KRUYT and J. OOSTERMAN: Flow potentials, electro-endosmosis and electrophoresis with platinum.

P. E. VERKADE, J. VAN DER LEE, A. J. S. VAN ALPHEN and M. ELZAS: Researches on fat metabolism (2). Injection experiments on dogs with sodium salts of normal saturated dicarboxylic acids.

E. DUBOIS: The fossil human skull recently described and attributed to *Pithecanthropus erectus* by G. H. R. von Koenigswald. The author disagrees with Koenigswald's conclusions, and criticizes his reconstruction of the (much broken) skull cap.

J. W. N. LE HEUX: Researches on some interference phenomena of vibration curves.

A. QUISPEL: A new method for the investigation of aerial and soil algæ. The surface to be studied is treated with 'Zaponlac' and acetone to fix the organisms and is then painted with gypsum, collodion or *Geiseltallack*. The cast is allowed to harden and is then stripped off, so removing the algæ quantitatively.

G. J. DE GROOT and J. B. THOMAS: Bio-electric potentials and the movements of the motile leaf pulvini in *Phaseolus multiflorus* L.

L. A. H. BOUWPAN: A new genus (*Kugleria*) of the family of Requienida (Pachyodonta).

R. L. STARKEY: Spore formation by the sulphate-reducing vibrio. The specific sulphate-reducing organism known as *Vibrio desulfuricans* produces spores which are very tolerant of high temperatures.

P. GLEES: Neuroplasmatic connexions between cells of the radix mesencephalica trigemini in *Scyllium canicula*.

G. P. FRETS: Dimension and form with the growth of the seeds of *Phaseolus vulgaris* L (2).

Brussels

Royal Academy (*Bull. Classe Sci.*, **24**, No. 2, 1938).

L. GODEAUX: Construction of surfaces and of algebraic varieties of divisor greater than one.

O. DONY-HÉNAULT: Discovery of the thermal metallurgy of zinc in Belgium at the beginning of the nineteenth century.

R. GERBAUX: A case of geometrical isomerism in the epoxy-nitrile series. The synthesis of two compounds believed to be *cis*- and *trans*- 2.3 epoxy-2-methylbutanitrile.

J. BRANDES: Precocious modification of the primordial morphogenesis in amphibians by the action of ultra-violet radiation.

Moscow

Academy of Sciences (*C.R.*, **18**, No. 7; 1938).

S. BERNSTEIN: (1) The best approximation of $[x-c]p$. (2) Limitation of modules of successive derivations of solutions of parabolic equations.

V. S. LUKCHIN: Some generalizations of the problem of infinitely small deformations of rotation surfaces with negative curvature.

B. GAGAEFF: The functions satisfying equations of elliptic type.

A. G. PINSKER: Analytical representation of some partially additive functions.

V. ŠMULIAN: The regularly closed and weak compact entities in a space of the type (*B*).

D. A. FRANK-KAMENECKIJ: (1) Non-stationary free convection. (2) The temperature distribution in a reaction vessel and the static theory of thermal explosions.

L. A. ARCIMOVIČ and V. A. CHRAMOV: Energy loss of fast electrons by radiation.

L. V. GROŠEV and I. M. FRANK: The probability of creation of pairs in krypton by γ-rays.

P. A. REHBINDER and A. A. TRAPEZNIKOV: Mechanical properties of films and stability of foams.

A. A. TRAPEZNIKOV and P. A. REHBINDER: Stabilizing effect of adsorption layers and their mechanical properties.

A. V. NIKOLAEV and A. G. ČELIŠČEVA: The synthesis of inyoite.

M. N. KALININ: Preparation of esters of the orthosilic acid.

O. E. ZVIAGINCEV and E. L. PISARŽEVSKAIA: The action of sulphide minerals on solutions of gold chloride and cyanide.

N. A. IZGARYŠEV and E. S. SARKISOV: Mutual displacement of metals from vapours of their salts and the application of this process in the prevention of corrosion.

N. NEKRASOV: The non-equilibrium oxidation-reduction potential.

P. L. BEZRUKOV: Lower Silurian geosynclinal phosphorites in the north-eastern branch of the Karatau Range.

A. E. FERSMAN: The tetrahedral structure of minerals.

N. A. SKOPINCEV: Organic matter in sea-water and foam in the south-eastern part of the Caspian Sea (October–November 1936).

DONTCHO KOSTOFF: (1) Studies on polyploid plants (18). Cytogenetic studies on *Nicotiana sylvestris* × *N. tomentosiformis* hybrids and amphidiploids, and their bearing on the problem of origin of *N. tabacum*. (2) Heterochromatic (inert) region in chromosomes of *Crepis capillaris*.

A. I. ZHURBIN: Comparative study of cell sizes of auto- and allopolyploids.

E. I. HARETSCHKO-SAWITZKAJA: A method for obtaining seeds in self-fertilization of autosterile varieties of *Beta vulgaris*.

A. I. POTAPOV: Soil reactions in the forests of Lenkoran and western Georgia from the point of view of citrus and tea cultivation.

C. S. AFANASIEV: A new valuable rubber plant (*Scorzonera kirgisorum* sp. n.) from the Pamiro-Alai.

D. K. TRETYAKOV: (1) External canaliculi of the lateral line of fishes. (2) Seismosensory canals in the flying fish.

A. A. WOITKEWITSCH: Morphogenetic activity of the various parts of the hypophysis.

R. J. KOVDA and A. A. WOITKEWITSCH: Biological action of an ultra-high frequency electric field.

B. NOVIKOV: Sex hormone and characters of partial monomorphism in *Perdix perdix* L.

A. M. VASIUTOČKIN: (1) The degeneration of seminal tubules. (2) Regeneration phenomena in frog intestine.

Washington, D.C.

National Academy of Sciences (*Proc.*, **24**, 165–198; April 15, 1938).

G. A. LEBEDEFF: Intersexuality in *Drosophila virilis* and its bearing on sex determination. Genetical and morphological investigation of some intersexes, which are morphologically hermaphrodites of all grades, indicates that they start to develop as females, but after the 'turning point', any imaginal disks which differentiate become male organs. The time at which the 'turning point' occurs determines the degree of maleness or femaleness of the adult hermaphrodite. Applying these results to normal sex determination, it is suggested that sex is determined by the balance between the gene for femaleness (in the *X*-chromosome) and that for maleness (in the third chromosome), the balance being maintained by suppressors controlled by the *XY* mechanism.

S. HECHT and E. G. PICKELS: Sedimentation constant of visual purple. Frog's visual purple was examined in an air-driven ultracentrifuge (160,000 times gravity). The single sedimentation boundary was photographed with both the blue and the green radiation from mercury, and gave experimentally the same value for the sedimentation constant. This

indicates that the asymmetry of the absorption curve is an integral property of the visual purple. Bleached visual purple gave the same constant, showing that bleaching does not cause drastic splitting of the molecule. The molecular weight is probably about 270,000 and the molecule itself not quite spherical.

B. H. WILLIER, MARY E. RAWLES and F. C. KOCH: Biological differences in the action of synthetic male hormones on the differentiation of sex in the chick embryo. The hormones were injected into eggs incubated for 43–72 hours. Androsterone and dehydroandrosterone are more toxic than testosterone propionate; the former have both masculinizing and feminizing effects, whereas the latter has a masculinizing effect only on differentiating gonads and gonoducts.

F. D. MURNAGHAN: (1) The generalized Clebsch-Gordan formula. (2) Analysis of representations of the real orthogonal group.

A. L. FOSTER: Natural systems.

H. M. MACNEILLE: Extensions of measure.

R. OLDENBURGER: Representation and equivalence of forms.

Forthcoming Events

Tuesday, June 28

NATIONAL PHYSICAL LABORATORY, at 2.30.—Annual Inspection by the General Board.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 9.—H. J. Braunholtz: "Ethnographical Museums and the Collector: Aims and Methods" (Presidential Address).

Thursday, June 30

ROYAL SOCIETY, at 4.30.—Prof. A. N. Richards: "Processes of Urine Formation" (Croonian Lecture).

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

JUNIOR SCIENTIFIC OFFICER at the Building Research Station, Watford—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (June 27—quote ref. *J.* 38/6).

PRINCIPAL of Wakefield Technical College—The Director of Education, 27 King Street, Wakefield (June 27).

LECTURER IN BOTANY in Bedford College for Women, Regent's Park, London, N.W.1—The Secretary (July 1).

LECTURER IN ELECTRICAL ENGINEERING in the Brighton Technical College—The Education Officer, Education Offices, 54 Old Steine, Brighton, 1 (July 1).

LECTURER IN MECHANICAL ENGINEERING in the School of Engineering, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (July 1).

ASSISTANT LECTURER IN MECHANICAL ENGINEERING in the Manchester Municipal College of Technology—The Principal (July 4).

DEMONSTRATOR IN PHYSIOLOGY and DEMONSTRATOR IN PHYSICS in the London (Royal Free Hospital) School of Medicine for Women—The Warden, 8 Hunter Street, W.C.1 (July 8).

DEMONSTRATOR IN BOTANY in the University of Birmingham—The Secretary (July 9).

CHEMIST in the Department of the Government Chemist—The Government Chemist, Clement's Inn Passage, Strand, W.C.2 (July 9).

IRWIN PROFESSOR OF AGRICULTURE in the Benares Hindu University—The Pro-Vice-Chancellor (July 15).

LECTURER IN ANATOMY in the University of Aberdeen—The Secretary (July 15).

DEMONSTRATOR IN PHYSICS in King's College, Newcastle-upon-Tyne—The Registrar (July 16).

GOLDSMID PROFESSOR OF MATHEMATICS in University College, London—The Academic Registrar, University of London, Senate House, W.C.1 (July 29).

SECRETARY of the Institution of Professional Civil Servants—The Hon. Secretary, I.P.C.S., 69 Victoria Street, London, S.W.1 (July 30).

SCIENTIFIC OFFICER under the Water Pollution Research Board—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (July 4—quote ref. *J.* 38/7).

ASSISTANTS (grade III) in the Meteorological Office—The Secretary (S.2.a.), Air Ministry, Adastral House, Kingsway, W.C.2.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Imperial Forestry Institute: University of Oxford. The Black Poplars and their Hybrids cultivated in Britain. By G. S. Cansdale and Members of the Staff of the Imperial Forestry Institute. Pp. 52+1 plate. (Oxford: Imperial Forestry Institute.) 3*s.* 6*d.* [136

University of Reading: National Institute for Research in Dairying. Annual Report for the Year ending 30th September 1937. Pp. viii+80. (Reading: National Institute for Research in Dairying.) [136

Department of Scientific and Industrial Research. Report of the Building Research Board, with a Report of the Director of Building Research, for the Year 1937. Pp. vi+172+13 plates. (London: H.M. Stationery Office.) 3*s.* 6*d.* net. [136

Agricultural Research Council. A.R.C. Report Series, No. 3: Dairy Research; a Report by the Dairying and Animal Products Committee on a Review undertaken by them of Dairy Research in Progress in Great Britain, including a Review of the Work of Dairy Bacteriologists in England and Wales. Pp. v+101+1 map. (London: H.M. Stationery Office.) 2*s.* net. [136

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vol. 19, 1937. Pp. 138+1 plate. (London: Chemical Engineering Group.) 21*s.* [136

Forestry Commission. Eighteenth Annual Report of the Forestry Commissioners for the Year ending September 30th, 1937. Pp. 50. (London: H.M. Stationery Office.) 1*s.* net. [136

Ministry of Health. Circular 1705: Maternal Mortality; Medical Practitioners called in by Midwives. Pp. 3. (London: H.M. Stationery Office.) 1*d.* net. [136

Association of Special Libraries and Information Bureaux. Select List of Standard British Scientific and Technical Books. Compiled at the request of the British Council. Second edition, revised and enlarged. Pp. 42. (London: ASLIB.) 2*s.* 6*d.* [136

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1807 (2822): Measurements of Acceleration and Water Pressure on a Seaplane when dropped into Water. By E. T. Jones, G. Douglas, C. E. Stafford and R. K. Cushing. Pp. 18+11 plates. 5*s.* net. No. 1811 (2807): Note on Wind Tunnel Tests on the Design of Cabins. By J. H. Hartley, D. Cameron and W. H. Curtis. Pp. 17+1 plate. 3*s.* net. No. 1813 (2920): Drag Tests on a Fabric covered, and a Polished Plywood, Wing in the 24 ft. Tunnel. By K. V. Diprose. Pp. 15. 2*s.* 6*d.* net. No. 1815 (3204): The Divergence Speed of an Elastic Wing. By A. G. Pugsley and G. A. Naylor. Pp. 20. 3*s.* net. No. 1817 (3194): Experiments on an Elliptic Cylinder in the Compressed Air Tunnel. By D. H. Williams and A. F. Brown. Pp. 10. 1*s.* 6*d.* net. No. 1820 (2873): Notes on a Method of Analysis of Ground Run during Take-off. By S. B. Gates. Pp. 13. 2*s.* net. (London: H.M. Stationery Office.) [136

The Colonial Empire in 1937–38: Statement to accompany the Estimates for Colonial and Middle Eastern Services 1938. (Cmd. 5760.) Pp. 79. (London: H.M. Stationery Office.) 1*s.* 3*d.* net. [136

Other Countries

Indian Science Congress Association: Silver Jubilee, 1938. The Progress of Science in India during the past Twenty-five Years. Edited by Dr. B. Prashad. Pp. lvi+767. (Calcutta: Indian Science Congress Association.) 5 rupees. [76

Light: Corpuscle *vs.* Wave. By Charles A. Spickler. Pp. 8. (Yardley, Penna.: The Author.) [136

Bericht über das Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1937. Von E. Rübel und W. Lüdi. Pp. 104. (Zürich: Geobotanische Forschungsinstitut Rübel.) [136

Publications of the Kapteyn Astronomical Laboratory at Groningen. Edited by Prof. Dr. P. J. Van Rhijn. No. 48: Dark Clouds in Kapteyn's Special Areas 2, 5, 9 and 24 and the Proper Motions of the Stars in these Regions. By B. Hiemstra. Pp. ii+74+1 plate. (Groningen: Hoitsema Bros.) [136

Progress Report on the Scheme of Research on Quality in Crops with special reference to Rice, during the Period December 1934 to November 1937. By Dr. A. Sreenivasan. Pp. 1+22. (Bangalore: Indian Institute of Science.) [136

Reports of the Great Barrier Reef Committee. Vol. 4, Part 3, Nos. 7, 8 and 9. Pp. 51–142+4 plates. (Brisbane: Government Printer.) [136

Canada. Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Limestones of Canada: their Occurrence and Characteristics. Part 4: Ontario. By M. F. Goudge. (No. 781.) Pp. xii+361+4 maps. (Ottawa: King's Printer.) 75 cents. [136

Egyptian University. Bulletin of the Faculty of Science No. 14: The Osteology of the Lizard *Scincus scincus* (Linn.). By M. R. El-Toubi. Pp. 38. 3.5 P.T. Bulletin of the Faculty of Science No. 15: Egyptian Soil Structure in relation to Plants. By A. H. Montasir. Pp. 47+5 plates. (Cairo: Egyptian University.) [146

San Diego Society of Natural History. Occasional Papers No. 4: A Statistical Study of the Rattlesnakes. By Laurence M. Klauber. Pp. 53. Transactions, Vol. 8, No. 33: New and Obscure Decapod Crustacea from the West American Coasts. By Steve A. Glassell. Pp. 411–454. Vol. 8, No. 34: A Study of the Skull of the Pleistocene Stork, *Ciconia maltha*, Miller. By Loye Miller. Pp. 455–462. (San Diego, Cal.: Society of Natural History.) [146

University of Illinois: Engineering Experiment Station. Circular No. 31: Papers presented at the Short Course in Coal Utilization held at the University of Illinois, May 25–27, 1937. Pp. 200. 50 cents. Bulletin No. 300: Pressure Losses resulting from Changes in Cross-Sectional Area in Air Ducts. By Prof. Alonzo P. Kratz and Julian R. Fellows. Pp. 58. 65 cents. (Urbana, Ill.: University of Illinois Engineering Experiment Station.) [146

Recent Scientific and Technical Books

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Bouligand, Georges. Lignes de niveau; lignes intégrales; introduction à leur étude graphique. Rédigée par Jacques Devisme. Roy. 8vo. Pp. viii +154. (Paris : Libr. Vuibert, 1937.) 30 francs.

Bourion, Georges. Exposés sur la théorie des fonctions. 8 : L'Ultraconvergence dans les séries de Taylor. (Actualités scientifiques et industrielles, 472.) Roy. 8vo. Pp. 47. (Paris : Hermann et Cie., 1937.) 12 francs.*

British Association for the Advancement of Science. Mathematical Tables. Vol 6 : Bessel Functions. Part 1 : Functions of Orders Zero and Unity. Prepared by the Committee for the Calculation of Mathematical Tables. Demy 4to. Pp. xx+288. (Cambridge : At the University Press, 1937.) 40*s.* net.*

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Durell, Clement V., and Robson, A. Hints for 'Advanced Algebra'. Cr. 8vo. Vol. 2. Pp. 32. 2*s.* 6*d.* net. Vol. 3. Pp. 32. 2*s.* 6*d.* net. (London : G. Bell and Sons, Ltd., 1937.)

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Jochmans, Gaston, et Descans, Fernand. Électricité et magnétisme. Roy. 8vo. Pp. 416. (Bruxelles : A. de Boeck ; Paris : Ch. Béranger, 1937.) 150 francs.*

Karamata, J. La théorie des fonctions. 6 : Sur les théorèmes inverses des procédés de sommabilité. (Actualités scientifiques et industrielles, 450.) Roy. 8vo. Pp. 47. (Paris : Hermann et Cie., 1937.) 12 francs.*

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Kramers, H. A. Quantentheorie des Elektrons und der Strahlung. (Hand- und Jahrbuch der chemischen Physik, herausgegeben von A. Eucken und K. L. Wolf, Band 1, Abschnitt 2.) Sup. Roy. 8vo. Pp. 223–502 +x. (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1937.) 26.80 gold marks.*

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Lewitt, E. H. Hydraulics and Mechanics of Fluids. Fifth edition. Demy 8vo. Pp. 435. (London : Sir Isaac Pitman and Sons, Ltd., 1937.) 10*s.* 6*d.* net.

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Muskat, M. The Flow of Homogeneous Fluids through Porous Media. With an Introductory Chapter by R. D. Wyckoff. (International Series in Physics.) Med. 8vo. Pp. xix+753. (New York and London : McGraw-Hill Book Co., Inc., 1937.) 45*s.**

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Radcliffe, William, Invented by. Radcliffe's Numervision. Set A : Number building 1 to 1,999. (London : The Author, 102 Chestnut Grove, S.W.12, 1937.) Teacher's Model, 7*s.* 6*d.**

Schaefer, Clemens. Einführung in die theoretische Physik. In 3 Bänden. Roy. 8vo. Band 3, Teil 2 : Quantentheorie. Pp. vii+510. (Berlin und Leipzig : Walter de Gruyter und Co., 1937.) 26 gold marks.*

Southall, James P. C. Introduction to Physiological Optics. Roy. 8vo. Pp. x +426 +3 plates. (London, New York and Toronto : Oxford University Press, 1937.) 21*s.* net.*

Stark, J., Herausgegeben von. Forschung und Prüfung : 50 Jahre Physikalisch-Technische Reichsanstalt. Sup. Roy. 8vo. Pp. vii +309. (Leipzig : S. Hirzel, 1937.) 10 gold marks.*

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Tables Annuelles Internationales et Constantes et Données numériques : International Annual Tables of Constants and Numerical Data. Index to Vols. 6–10,

Years 1923–1930. Demy 4to. Pp. xxiv+48+304. £3. Vol. 11 (Years 1931–1934). Part 1 (Sections 1–25). Sup. Roy. 8vo. Pp. xiv+492+xv–xxv. (Paris: Hermann et Cie.; New York: McGraw-Hill Book Co., Inc., 1937.)*

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Wilson, H. A. Modern Physics. Second edition. Med. 8vo. Pp. 432. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 30*s.* net.

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Ibbetson, W. S. Electric Wiring. Cr. 8vo. Pp. 260. (London: E. and F. N. Spon, Ltd., 1937.) 6*s.* net.

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Kari, Alexander. Design and Cost Estimating of all Types of Merchant and Passenger Ships, a Treatise: Methods of arriving at Correct Proportions, Form and Power to attain Minimum Capital Cost with Maximum Service Efficiency. Fourth edition, revised and greatly enlarged. Roy. 8vo. Pp. xiv+396. (London: The Technical Press, Ltd., 1938.) 42*s.* net.*

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Kempe, H. R., and Hanneford-Smith, W., Originally compiled by. The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1938: a Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Forty-fourth annual Issue, completely revised under the direction of L. St. L. Pendred. Cr. 8vo. Pp. lxv+xv+2816. (London: Morgan Bros. (Publishers), Ltd., 1938.) 31*s.* 6*d.* net.*

Kent, C. G., assisted by Morris, J. C. The Construction of Main Sewers: including the Timbering of Excavations. Demy 8vo. Pp. xi+286+31 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 25*s.* net.*

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McGuire, P. W. Steam and Other Useful Tables: for Engineers and Steam Users. Pp. 101. (London: E. and F. N. Spon, Ltd., 1937.) 1*s.* 6*d.* net.

Müller, Georg. Garagen in ihrer Bedeutung für Kraftverkehr und Städtebau: Privater und gewerblicher Garagenbau in Planung und Gestaltung. 8vo. Pp. xi +293. (Berlin: Julius Springer, 1937.) 46.50 gold marks.

Munro's Engineers' Annual, Pocket Log and Diary. With which is incorporated "Donaldson's Engineers' Annual, 1938". Completely revised. Cr. 8vo. Pp. 183. (Glasgow: James Munro and Co., Ltd., 1937.) 2*s.* 6*d.* net.

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Pye, D. R. The Internal Combustion Engine. (Oxford Engineering Science Series.) Vol. 1. Second edition. Roy. 8vo. Pp. xvi +294. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15*s.* net.*

Royal-Dawson, F. G. Motorway Flyovers and Mountain Roads, with Details of Location. Cr. 8vo. Pp. 176. (London: E. and F. N. Spon, Ltd., 1937.) 8*s.* 6*d.* net.

Severns, William H. Heating, Ventilating and Air Conditioning Fundamentals. Med. 8vo. Pp. v +467. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 20*s.* net.*

Sothern, J. W. M. Marine Diesel Oil Engines: a Manual of Marine Oil Engine Practice. Fifth edition. Med. 8vo. Pp. 1084. (London: The Technical Press, Ltd., 1937.) 50*s.* net.

Still, E. W. The Calculation of Convective Heat Flow. Cr. 8vo. Pp. 24. (London and Manchester: Emmott and Co., Ltd., 1937.) 1*s.* net.

Timoshenko, S. Vibration Problems in Engineering. Second edition. Med. 8vo. Pp. x+470. (London: Constable and Co., Ltd., 1937.) 24*s.*

Titterton, George F. Aircraft Materials and Processes. Demy 8vo. Pp. 328. (London: Sir Isaac Pitman and Sons, Ltd., 1937.) 15*s.* net.

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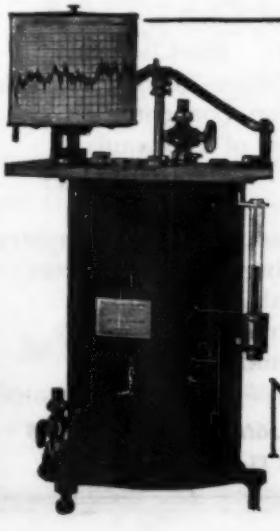

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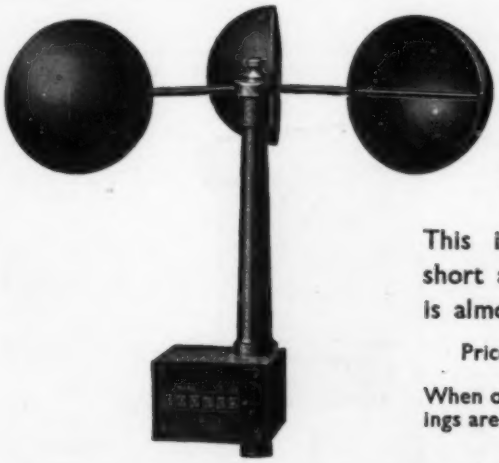

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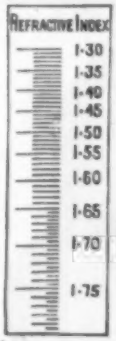

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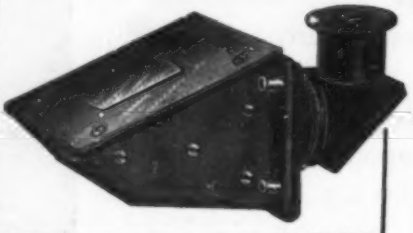

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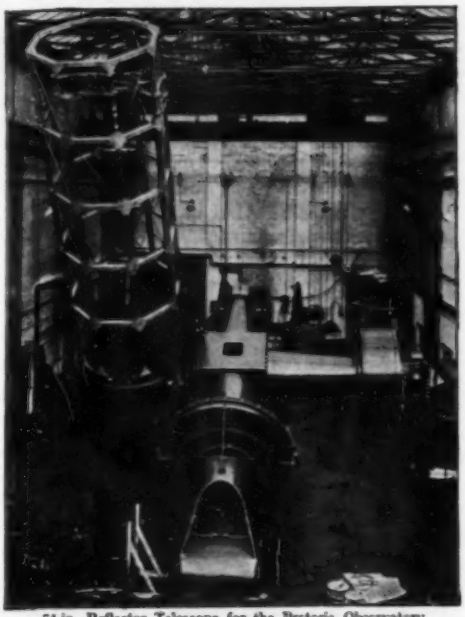

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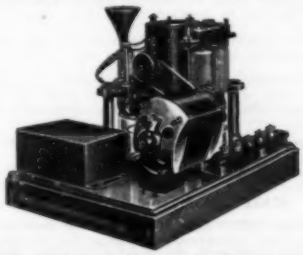

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(Official and Small Advertisements continued from page cclii.)

AIR MINISTRY

METEOROLOGICAL OFFICE

Applications are invited for appointment as Technical Officer (Male) in the Meteorological Office. Candidates must not be less than 21 and not more than 27 years of age on 2nd July, 1938, and must possess an Honours Degree in Mathematics or Physics. Candidates are not debarred from applying by the fact that the results of examinations already taken have not yet been announced, but ultimate selection for appointment would be conditional on proof of having passed. (Candidates applying in such circumstances should as soon as possible write to the address given below, stating the results of their examination.)

The salary scale is £275 per annum, by annual increments of £18 to £455 per annum, and thence by annual increments of £25 to £500 per annum. There is an efficiency bar at £455. Technical Officers are eligible for promotion to higher posts on the establishment of the Meteorological Office. The posts are pensionable.

Candidates should apply on a form to be obtained from the Secretary (S.2.a), Air Ministry, Adastral House, Kingsway, London, W.C.2. The closing date for the return of completed application forms is 2nd July, 1938.

AIR MINISTRY

METEOROLOGICAL OFFICE

Assistants, Grade III (male) required as early as possible in the Meteorological Office. Candidates must be not less than 17 and not have attained the age of 20 on the 30th June, 1938, and must have passed the Intermediate Science Degree Examination, or reached an equivalent educational standard. (Note: The Leaving Certificate of the Scottish Education Department will be accepted as an equivalent, subject to certain conditions.) Candidates are not debarred from applying by the fact that the results of examinations already taken have not yet been announced, but ultimate selection for appointment would be conditional on proof of having passed.

Salary scale £130—£12—£214—£12—£310 a year. A deduction of £10 is made for each year or part of year below age of 19.

Assistants III are eligible in due course to be considered for promotion to Assistant II (£315—£385 a year) and Assistant I (£400—£515 a year). The appointments will be non-pensionable but entrants will be eligible for consideration for appointments to pensionable posts in the event of vacancies arising on the permanent establishment.

Candidates who have not previously made application should apply on a form to be obtained from the Secretary (S.2.a), Air Ministry, Adastral House, Kingsway, W.C.2. Candidates who have taken the Leaving Certificate of the Scottish Education Department should indicate the subjects and whether on the higher or lower grade.

WAR DEPARTMENT

JUNIOR LECTURER required on the electrical side of the Mechanical and Electrical Engineering Branch of the Military College of Science, Woolwich.

Candidates should preferably be under 35 years of age, and possess a University Honours degree. A knowledge of the principles and practice of Radio communications is desirable.

Annual salary scale: £300 by £18 to £400. The minimum of £300 will be reduced by £10 for every year by which the Junior Lecturer on appointment falls short of the age of 23.

The Federated Superannuation System for Universities will apply.

After 5 years' service as Junior Lecturer the successful candidate may expect, if he serves so long, advancement to the Lecturer grade on an annual salary scale of £400 by £18 to £454 by £25 to £600, if certified competent to perform the highest duties of the higher grade.

Increments are granted annually, subject to approved service.

Successful candidate will be required to take up his duties as early as possible.

Ex-service candidates given preference other things being equal.

Application form obtainable by post-card from the Commandant, Military College of Science, Red Barracks, Woolwich, S.E.18, to be lodged not later than 6th July, 1938.

WAR DEPARTMENT

STAFF FOR SCIENTIFIC RESEARCH

ASSISTANTS III (Male) required to carry out experimental development work on radio communication. Successful candidates would be posted in the first instance to the Bawdsey Research Station, Bawdsey Manor, Woodbridge, Suffolk.

Candidates should preferably be under 30 years of age, and have had laboratory or work experience in radio engineering, and training up to the standard of a University Degree in Physics or Electrical Engineering.

Salary Scale £120 by £12 to £310 a year (Efficiency bar at £214). A deduction of £10 to be made for each year or part of year below age 19 on entry. Higher commencing salary up to £214 may be approved according to age, qualifications and experience, and in this connexion the possession of a University Degree will be taken into consideration.

The appointments are not pensionable.

Promotion and/or appointment to a pensionable post is governed by merit and suitability as and when vacancies arise.

Ex-service candidates given preference, other things being equal.

Application forms obtainable by post-card from the Secretary, Royal Engineer and Signals Board, Regents Park Barracks, Albany Street, London, N.W.1, to be lodged not later than 9th July, 1938.

GOVERNMENT LABORATORY

A competition, open to both men and women, will be held to fill a vacancy in the grade of Chemist in the Department of the Government Chemist. Present salary scale £375 to £580 (men), £275 to £464 (women). Age limits 23—28 on the 9th July, 1938.

Candidates must possess a University degree with first or second class honours in Chemistry, or the Associateship of the Institute of Chemistry, and must have had at least one year's post-graduate experience in chemical work on the 9th July, 1938. They should have a working knowledge of technical French and German.

Forms of application, together with regulations relating to the appointment, obtainable from the Government Chemist, Clement's Inn Passage, Strand, W.C.2, to be returned not later than 9th July, 1938.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

A SCIENTIFIC OFFICER is required for research in the programme of the Water Pollution Research Board, in the first place for investigating methods of treatment of sewage and trade effluents on a large scale at works. Candidates should have a good honours degree or equivalent qualification in chemistry or biology and considerable research experience. The scale of salary for men is £400 by annual increments of £18 to £454, thence by £25 per annum to £600; there is an efficiency bar at £580. The scale for women is £350 by £18 per annum to £464 (efficiency bar) by £25 to £580. Exceptionally a commencing salary up to £454 (women £404) may be granted depending upon the qualifications and experience of the selected candidate. Appointment will carry superannuation under the Federated Superannuation System for Universities.

Application must be made not later than Monday, 4th July, 1938, on a form to be obtained on request (by postcard, quoting reference J. 98/7) from the Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

(Faculty of Technology in the University of Manchester)

Appointment of

ASSISTANT LECTURER IN MECHANICAL ENGINEERING

The Governing Body invites applications for an Assistant Lectureship in Mechanical Engineering in the College of Technology, with the title and status of Assistant Lecturer in the University of Manchester.

Salary: £300 per annum.

Conditions of appointment and form of application may be obtained from the Registrar, College of Technology, Manchester. The last day for the receipt of applications is *Monday, 4th July, 1938*.

Canvassing, either directly or indirectly, will disqualify a candidate for appointment.

B. MOUAT JONES,
Principal of the College.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

APPOINTMENT OF PRINCIPAL

The Education Committee of the City of Manchester and the University of Manchester jointly invite applications for the office of Principal of the Municipal College of Technology.

Salary: £1,500 per annum.

Particulars of the duties required may be had from the Director of Education, Education Offices, Deansgate, Manchester 3, and the last day for the receipt of applications, which should be sent to him, is Thursday, 30th June, 1938.

Canvassing members of the Committee, either directly or indirectly, will disqualify a candidate for appointment.

W. O. LESTER SMITH,
Director of Education.

June, 1938.

UNIVERSITY OF CAPE TOWN

CHAIRS OF PHYSIOLOGY AND PURE MATHEMATICS

Applications are invited for the following Chairs vacant from March, 1939, viz.:

(a) Chair of Physiology: the salary is £1,000 per annum rising by £50 per annum to £1,100.

(b) Chair of Pure Mathematics: the salary is £900 per annum rising by £25 per annum to £1,000.

Applications (six copies) must reach the Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (from whom forms of application and further particulars are obtainable), not later than 22nd July, 1938. Applicants, in addition to submitting copies of testimonials, must give the names of three referees.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)

REGENT'S PARK, N.W.1

The Council of Bedford College invites applications for a temporary Lectureship in Mathematics for one year starting 1st October, 1938. Salary from £325 a year, according to qualifications. The post is open to men and women equally.

Last date for receiving applications, Thursday, 30th June. For further particulars apply to the Secretary.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)

Regent's Park, N.W.1

The Council of Bedford College invites applications for the following post, open to men and women equally, vacant as from 1st October, 1938:

Lecturer in the Department of Botany. Candidates must have an Honours degree in Botany. Salary £350—£500. Initial salary may be above the minimum of the scale for a candidate with special qualifications.

Last date for receiving applications, Friday, 1st July, 1938. For further particulars apply to the Secretary.

THE INSTITUTION OF PROFESSIONAL CIVIL SERVANTS

invites applications for the vacant post of SECRETARY of the Institution on a salary scale of £750 rising by annual increments of £25 to £900 per annum.

Special consideration in respect of commencing salary will be given to applicants possessing exceptional qualifications for the post.

The Secretary is the principal salaried officer of the Institution (membership approximately 15,000) and is responsible, under the direction of the Honorary Officers and Council for the conduct of negotiations on the Institution's behalf, and for the supervision of the office of the Institution.

Applicants, who may be required to undergo a medical examination, must not be less than 30 years of age. The officer appointed will be required to serve a probationary period of 12 months.

The post is pensionable under a scheme similar to that of the Federated Universities, whereby the officer appointed contributes 5 per cent of his salary and the Institution contributes an additional 10 per cent.

Forms of Application and Full Particulars of the post may be obtained from the Honorary Secretary, I.P.C.S., 69 Victoria Street, London, S.W.1.

Applications must reach the Honorary Secretary not later than 30th July.

SUDAN MEDICAL SERVICE

Applications are invited for the post of junior British Laboratory Assistant, male, unmarried, in the Stack Medical Research Laboratories, Khartoum, to commence duty on 15th November, 1938.

The salary commences at LE.324 or LE.360 (LE.=£1 0s. 6d.), according to age and qualifications, rising by 2-3 yearly increments to LE.780 after 18 or 20 years depending on the initial rate. The appointment carries prospects of pensionable service after 5 years' service. A free passage to the Sudan will be provided.

Candidates should be between 22 and 30 years of age and should hold the Laboratory Assistants Diploma of Bacteriological Technique, and preferably have some experience in Clinical pathology.

Applications, stating age, qualifications and copies of testimonials, should be sent to Dr. H. C. Squires, 90 Harley Street, W.1.

SUDAN GOVERNMENT

(Agricultural Research Service) has vacancy for PLANT PATHOLOGIST. Man required with good honours degree and with research experience in Plant Pathology or pure Mycology. Age 23-30. Good physique. Starting salary £E.540-600 per annum according to qualifications and experience, rising to £E.1,000. (£E.1=£1 0s. 6d.)

For further particulars and application forms apply Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1.

Applications for post must reach that office not later than 15th July 1938. (Envelope marked "PLANT PATHOLOGIST".)

SUDAN GOVERNMENT

has vacancy for PLANT PHYSIOLOGIST to take up duties in October, 1938. Requires man with good honours degree and with research experience in Plant Physiology. Age 23-30. Medically fit. Starting salary £E.540-600 per annum according to qualifications and experience, rising to £E.1,000. (£E.1=£1 0s. 6d.)

Further particulars and application forms can be had from the Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1.

Applications for post must reach that office not later than 15th July, 1938. (Envelopes marked "PLANT PHYSIOLOGIST".)

UNIVERSITY OF BIRMINGHAM

DEPARTMENT OF BOTANY

Applications are invited for the post of Temporary Demonstrator in the Department of Botany for the session 1938-9. Stipend at the rate of £200 per annum.

Applications must be sent on or before 9th July to the undersigned.

C. G. BURTON,
Secretary.

The University,
Birmingham, 2.

UNIVERSITY OF BRISTOL

The University invites applications for a TEMPORARY ASSISTANT LECTURER IN ZOOLOGY (Grade III). Salary £300 p.a.

Applications should reach the undersigned, from whom further particulars should be obtained, on or before 7th July, 1938.

WINIFRED SHAPLAND,
Secretary and Registrar.

UNIVERSITY OF DURHAM

KING'S COLLEGE, NEWCASTLE-UPON-TYNE

Applications are invited for the post of Demonstrator in Physics, an ungraded post tenable for three years at a salary of £250 a year. Appointment from 1st October, 1938. Twelve copies of applications and of not more than three testimonials should be lodged not later than Saturday, 16th July, 1938, with the Registrar, King's College, Newcastle-upon-Tyne, 2, from whom further particulars may be obtained.

UNIVERSITY OF LONDON

The Senate invite applications for the Goldsmid Chair of Mathematics tenable at University College. The Chair is not restricted to any particular branch of Mathematics, but the Professor will be expected to give special attention to some branch of Mechanics or Applied Mathematics. Salary £1,000 a year. Applications (12 copies) must be received, not later than first post on 29th July, 1938, by the Academic Registrar, University of London, Senate House, W.C.1, from whom further particulars should be obtained.

FELLOWSHIP

The Eugenics Society offers a LEONARD DARWIN FELLOWSHIP of £250 for one year from the 1st October, 1938, renewable for a second year, tenable in any approved Institution in the United Kingdom, for Research on subjects bearing on Eugenics, such as the quantitative study of genetics and evolution, human heredity, vital statistics, fertility, the eugenic effects of economic conditions and legislation, etc. Forms may be obtained from the Business Secretary, The Eugenics Society, 69 Eccleston Square, London, S.W.1, to whom applications for the Fellowship should be sent on or before the 31st of July, 1938.

LEICESTER MUSEUM

Assistant (male) wanted. Must have knowledge of Zoology and some practical experience in mounting specimens. Salary £182 10s. 0d. per annum rising to £300 per annum.

Applications to be made not later than 10th July, on form to be obtained from the undersigned.

E. E. LOWE,
Director.

14th June, 1938.

UNIVERSITY OF MANCHESTER

Applications are invited for the post of a Laboratory Steward in the Department of Chemistry. Applicants, who should be not more than forty-five years of age, should possess technical ability and some administrative experience. Salary £275 to £312, according to qualifications. Particulars of duties may be had from the Assistant Director of Chemical Laboratories. Envelopes should be marked "Steward". Last date for receiving applications 12th July.

UNIVERSITY COLLEGE, NOTTINGHAM

The Council invite applications for the following appointments:

LECTURER IN PHARMACEUTICAL CHEMISTRY, salary £300-360 according to qualifications and experience, as from 26th September.

ASSISTANT LECTURER IN CHEMISTRY, commencing salary £250, as from 15th September.

Further information and forms of application, which must in each case be returned not later than Monday, 11th July, may be obtained from the Registrar.

Technical assistant required by professional man engaged in chemical, brewing and similar work. Young man with sound knowledge of such processes can find a good position. Apply Box OA/5, c/o The Review Press, Limited, 13 Little Trinity Lane, London, E.C.4.

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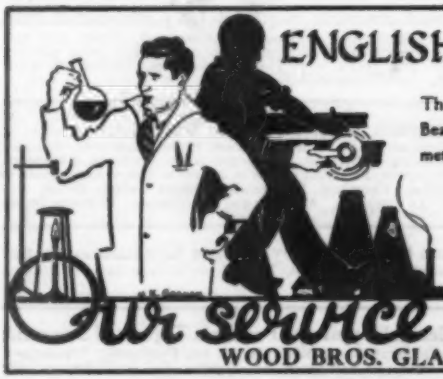

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